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CCXCV.—PALM WEEVIL IN BRITISH HONDURAS.

(With two Plates.)

I.—Introduction.

The industry of cocoa-nut palm growing, established within recent years in British Honduras, has been seriously discouraged during the past five or six years by the attacks of the insect commonly known as the Palm Weevil on the trees, a large proportion of which have been killed.

In the year 1888, the Government of British Honduras recognised the fact that the annual loss thus incurred menaced the prosperity of the Colony, and therefore appointed a Commission to examine into and report on these attacks.

The Commissioners issued their report (26)* early in 1889, and the Government, acting upon the recommendations contained in it, issued a draft ordinance. This ordinance, which was designed to enforce under penalties the destruction of attacked trees, and was of a very stringent character, was not persevered in and did not become law.

A defect in the Commissioners' report was the absence of any evidence of steps having been taken to identify or describe the insect concerned, or to submit it for the purpose of being examined by a competent entomologist. In order to remove all possibility of doubt as to its identity, the Government of British Honduras sent over a series of specimens. These consisted of the cocoons and of the pupæ preserved in spirit of the American Palm Weevil or of an allied species, but in the absence of perfect insects they could not be exactly determined.

In the autumn of 1892, specimens of the mature beetles were received at the Royal Gardens, Kew, both from the Government and from Mr. C. T. Hunter, of Belize, who is largely interested in the industry concerned.

The specimens belonged to two species of weevils, of which the majority were, as was anticipated would be the case, examples of the well-known American Palm Weevil (*Rhynchophorus palmarum*, Linn.).

It was then decided to publish an account of the known habits and economic treatment of this insect, so as to present them in a convenient

* This and similar figures in the text refer to the bibliography at the end of this paper.

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form for the use of planters engaged in cocoa-nut palm growing, who, according to the Commissioners, appear to be generally "unacquainted with the various stages in the existence of the Weevil;" and to serve as a guide towards obtaining a more thorough knowledge of the insect's habits and of the class of measures most efficient in keeping it in check. The present paper has been written and is published as the result of that decision.

As the insect under consideration, as well as the species immediately allied to it, is confined to tropical or sub-tropical regions, and no observations whatever can be made in this country upon its habits or life-history, the present account is of the nature of a compilation, and the accuracy of much of its information depends upon and is limited by that of the records supplied by investigators in tropical countries. That information is necessarily deficient in some respects, and the responsibility of adding to and correcting it rests with those engaged in cocoa-nut growing, who have opportunities for testing the statements made.

However, the comparison of accounts written by individual observers both of this insect and of allied species is most valuable in order to bring out the importance of certain facts and to check erroneous conclusions arrived at by persons who have no previous experience of such questions to guide them.

In order to keep the text free from technicalities, which are confusing to a non-scientific reader, these have been reduced to a minimum, and terminology and systematic descriptions have been relegated to a final section, while a certain amount of information which is already familiar to the cocoa-nut planter is given to complete the account for other readers. This course has necessitated some unavoidable repetition of descriptive facts.

The order adopted is as follows: firstly, a summary of the materials upon which the following account is based; secondly, a description of the life-history and habits of the Palm Weevil in all its stages; thirdly, a discussion of the economic features of its attacks; and lastly, practical suggestions.

At the end is a list of those works and reports in which the life-history of the Palm Weevil is mentioned at greater or less length, and of some others to which reference is made. It has not been thought necessary to give a list of all the older works on insects in which this insect is referred to. Such accounts are frequently copied from some other source and are of no value. A fuller list will be found, if desired, in Schönherr's *Genera et Species Curculionidum*.

II.—Sources of Information.

The Palm Weevil of Central and South America (*Rhynchophorus palmarum*, Linn.) is one of the tropical insects, with which zoologists have been longest familiar, for Mdlle. Merian, in her remarkable *Dissertation sur la Génération et les Transformations des Insectes de Surinam*, &c. (1) published in 1726, gave a good and recognisable drawing of the beetle, and of its grub, which she described as follows:—

"The Dutch name it *Palmyt-Worm*, that is, the Worm of the Palm, because it feeds on that tree. In the trunk of the palm tree swarm certain worms feeding on the pith. At first no larger than cheese-maggots, they grow like the one here represented. Certain folk grill them, and consider them a most savoury morsel. From this worm

comes a black beetle, such as I have depicted, which the Indians and the Dutch both call the *Mother* of the palm worm" (p. 48).

The insect having become known at this early date, was figured in many of the early works on entomology down to the present century, and received from Linnæus the scientific name of *Curculio palmarum*. Linnæus' large genus *Curculio* was soon split up by zoologists, and the palm-weevil has been called by Herbst *Rhynchophorus palmarum*, and by Fabricius *Calandra palmarum;* both names are common and used to denote the same insect, but the former is now definitely established and accepted. Other generic names proposed for it have never come into general use.

The early entomologists worked out the position of the insect in classification, but added nothing to Mdlle. Merian's account, upon which they were content to draw. The fact of the grub or *gru-gru worm* being eaten by the natives and even by Europeans proved of more interest than its injurious habits, then of little importance, and certain ingenious statements were made, with an apparent disrespect for geography, to show that it was the Cossus of Pliny and the Roman epicures. Many authors (1, 3, 6, 9, 11), among whom are Kirby and Spence, and Schomburgk, speak of the grub being served as a delicacy, and it is obtainable by epicures of the present day at some of the West Indian hotels particularly in Martinique. This interesting fact need not be further dwelt upon, for it is improbable that there will be a sufficient demand for this dainty to counterbalance the insect's capacity for destructiveness; but if it should become popular as an article of food in Honduras, a certain additional impetus will be forthcoming to the work of searching for and destroying, or rather collecting, the grubs.

In 1828, the Rev. Lansdown Guilding, in a valuable but rarely consulted paper (3), described briefly the injuries which this weevil inflicts upon sugar-cane, as did Sir Robert Schomburgk in his book on Barbados (11) published in 1847.

From that date, and owing to the increased importance of tropical agriculture in modern times, scattered references to it as an injurious insect are to be found in different works, but the only detailed account of its habits appears to be that presented to the Government of British Honduras in 1889, in the Report of Messrs. Phillips, Bellamy and Dr. Gabb (26). In 1880, Miss Ormerod gave particulars of its attacks on sugar-cane in British Guiana (19). There are some valuable notes on it in *Insect Life*, U. S. Department of Agriculture, contributed by Mr. J. B. Hickey and the editors (32); and information is given in the same journal (25), and by Mr. S. V. Summers in the *Canadian Entomologist* (13), on a closely-allied species, the Palmetto Weevil, *Rhynchophorus cruentatus*, Fabr. (= *Zimmermannii*, Fåhr.), a native of Florida and the Southern States of North America.

The above form the principal sources of information, together with particulars given in conversation with the writer by Mr. C. T. Hunter, of Belize. These have been most valuable in several respects.

Besides the American Palm-Weevil, there is another and distinct species, the Asiatic Palm Weevil, or "red-beetle" of the planters, (*Rhynchophorus ferrugineus*, Fabr.), a native of India and the Malay region, which also attacks the cocoa-nut palm, and closely resembles its American congener in habits. There has always been a tendency on the part of writers to confuse these two species, a tendency which no doubt has caused the geographical vagaries referred to. Though closely allied they differ in appearance, if not in habits; and it is desirable to remember that writers who speak of the Palm Weevil in Asia as

Rhynchophorus or *Calandra palmarum* are referring to *R. ferrugineus*, and not to the American weevil.

Attention to this point is necessary, particularly in the study of periodicals devoted to tropical agriculture, in which the mistake is constantly made.

It is desirable to examine into the habits of both species together in order to solve the problems which they present, but caution is necessary in the comparison and in reconciling any discrepancies which they may present. At the same time the writer cannot point to any well-marked difference in their habits.

The information on the Asiatic Palm Weevil consists of letters to *The Tropical Agriculturist* (21), for the most part reproduced in *All about the Coco-Nut Palm* (22), and of short accounts in other agricultural works (24, &c.); also of reports made to the Government of the Straits Settlements, who proposed an ordinance similar to that of the Government of British Honduras. The best of these is a valuable one by Mr. H. N. Ridley, F.L.S., Director of Gardens and Forests, Singapore (30). There are also various letters in newspapers of that colony (27).

III.—Habits and Life History of the Palm Weevil.

The Palm Weevil is one of the largest insects contained in that very important and extensive group of beetles, the Weevils, of which the most characteristic feature is the prolongation of the head forwards so as to form a snout or *rostrum*, sometimes of great length, into the sides of which the horns or *antennæ* are inserted. The snout, which is always distinguishable in the true weevils, bears at its extreme tip the mouth, very small but nevertheless efficient.

The mouth is used for feeding, and by the females in drilling holes, which operation is rendered possible by its position at the end of the snout, or in nibbling patches from the rind of plants in which the eggs are then laid. There has been a good deal of misunderstanding about the snout of the Indian Palm Weevil, and it has been several times said that that insect possesses no alimentary apparatus whatever. This is not the case. The beetle, like other weevils, which are, as a rule, long-lived insects in the adult state, can and does feed, and the observer, mindful of the elephant, has probably looked for the mouth under the head, at the base of the snout, which he has taken to be merely a horn with penetrating power limited by the force with which the beetle can drive it in. The insect can pierce far harder tissues by gnawing than it could ever do by mere pushing.

Weevils possess a hard convex body of oval or cylindrical shape, rigid slowly-moving legs, and four-jointed feet, with broad flattened soles. Like other beetles, they pass through a series of transformations after leaving the egg, and before becoming adult. The first stage after the egg is that of the *larva*, or grub, in which all growth, that is, all increase in weight or bulk, takes place, and this stage is commonly the one in which the insects, feeding voraciously, are actively injurious. But sometimes the mature weevils are more mischievous than their grubs.

A weevil grub always feeds away from the light in the inside of a plant, in the seeds, wood or stem, the leaf substance, &c., and, like other internal-feeding larvæ, is white or yellowish. The head, of a darker colour, is well developed, stout and horny, with strong jaws, and is somewhat vertical, with the mouth situated below. The body is short and thick, swollen in the middle, and tapering at either end; it is

generally much wrinkled, and bent into a more or less conspicuous curve, so that the under side is concave. Legs are entirely absent, or are at most represented by six small tubercles on the three rings succeeding the head, so that the grub can only move in its burrow by the writhing of its body, and in some kinds by the assistance of horny projections with which the tail is furnished.

If attention is paid to the above features, it is easy to distinguish a weevil grub from that of any other insect, but the points of difference between the larvæ of different weevils are small, and but little known, so that great caution is necessary in determining a larva of which the identity is doubtful.

When the grub has become mature by continuous feeding, broken, however, by intervals when it changes its skin and emerges from its old garment clad in a new and larger one, it transforms by a further change of skin into a *pupa*. This takes place near the surface of the plant, so that the perfect insect, whose burrowing powers are in most of the true weevils limited, can break without difficulty through the structures which shield it from the air.

The *pupa*, sometimes enclosed in a cocoon or covering constructed by the grub, resembles the perfect insect, but is soft and pale with the wings and limbs neatly folded down on its under side. The limbs are separately enclosed in a thin skin which is not continuous over the surface, as in the pupa of a moth. As a pupa the insect lies dormant for a shorter or longer time, taking no food and being absolutely harmless. At last the perfect beetle, which has slowly matured in the pupal covering, throws it off and issues forth. It is at first soft and pale, and remains in shelter till its outer integuments have hardened, when it sets forth on its work of feeding and reproduction.

If an American Palm Weevil is carefully examined from above, it is seen to be a large oval beetle with its upper surface slightly flattened and of a deep velvety-black, with little or no lustre. Specimens which are glossy appear to have lost their velvety pile by being rubbed, and have probably emerged some time ; they frequently have a shiny streak along the middle of the back, while the sides are dull. Three main divisions can be made out in the body ; the *head*, prolonged into the beak ; the *thorax*, extending from the head to the wing-cases, and gradually becoming wider ; and the hind body, or *abdomen*, which completes the body, and is covered, except for its last quarter, by the ribbed wing-cases, or *elytra*, which, when the animal is not flying, meet each other accurately along the middle line of the back, except for a small triangular piece at their base (the *scutellum*), and are of the same horny consistency as the rest of the body. They cover over the much larger hind wings—the pair used in flight—which are folded up underneath.

The *head* is short and small, except for the beak, which extends forwards and downwards in a gentle curve, and bears the small mouth at its tip. In some specimens the snout is slender, and its base is studded with small distinct punctures ; in others it is stouter, the punctures are coarser, and tend to run together, so that the surface is wrinkled, and there is a slight ridge or keel along the middle of its upper surface, which runs forward into a somewhat flattened space near the tip. This space bears a dense brush of short black hairs growing vertically upwards, and looking as if they had been trimmed off with a pair of scissors. The latter insects are males ; those with the slender hairless snouts are females, and the distinction is of great importance, as the only one that can be relied on to separate the sexes. It can always be made out with a little practice, even in males that have worn off the brush of hair. The female is on an average slightly bigger and bulkier than the male,

and there are minute differences in the structure of the hind segment, but these are not to be depended on. The statement that all the larger and more bulky specimens are females is wrong; both sexes are very variable in size.

At the base of the snout are inserted the *antennæ* or horns, constructed of eight joints, the first of which, as in most weevils, is long, and set at an angle to the rest; the following six joints are small and bead-like, and the last is large and flattened, and looks as if it had been cut off abruptly, having a soft and spongy terminal surface.

The *thorax*, strictly the pro-thorax, and only the anterior part of the true thorax, which can be seen on the under side to extend as far as the hind legs, is apparently made up of one piece without join except for the insertion of the fore legs, another feature characteristic of the weevils.

The *legs* are short and powerful, the hinder pair being attached to the body very far back; each consists of a thigh, a shank, and a four-jointed foot.

The shank is not set with spines except at the apex, where there is one directed inwardly.

The structure of the weevil is not adapted for burrowing into hard vegetable tissues, and it does not do so, though it may creep into crevices, or dig its way into loose, rotten material and soft structures like the split cabbage of a palm, in which they are sometimes found. In boring beetles the body is narrow and cylindrical, so as to fit the burrow, and the snout, if present, is short and strong, while the shanks, as a rule, are strengthened with teeth or spines set along their outer edge, sometimes for excavating, usually to resist the friction of burrowing, and to throw out of the burrow the débris that is bitten away. The Palm Weevil, with its unarmed shanks and its very small mouth, would have great difficulty in making a hole big enough to accommodate it in the trunk of a tree, and when specimens are found inside a tree, they have got there either through a wound, by entering the hole of another insect, or the soft parts of the split bud, or have been bred in the tree and not yet quitted it. In the latter case the immature beetles will be found near the surface with a thin layer of rind between them and the outer air, through which they can easily break. One observer speaks of finding the "parent beetle and three large grubs wrapped in the fibre about three inches from the bark" (26). The beetle certainly was not the parent of the grubs, and it must be distinctly borne in mind that, except perhaps when the tree has external wounds, the beetle does not bore but lays its eggs from the outside.

The perfect weevils are mainly nocturnal in habit, and fly at dusk or by night with a loud booming noise (the Indian weevil is said, however, to fly frequently by day as well) (27). They hide from daylight in rubbish at the foot of the trees, and occasionally, it is stated, burrow in sand (26); they are also to be found concealed in the folds of the leaf-sheaths and the matted fibre of the head of the tree, or in the holes made by other insects. They feed freely on decaying sap or fruit, such as mangoes or bread-fruit, and on the rotten tissues of the palm-cabbage and pith, to which they are attracted by the smell of the fermenting juices, a circumstance that affords the readiest and best means of capturing them.*

In the adult state they are not known to injure the palms for the purpose of feeding, and as they are the parents of further broods of destructive grubs, the chief point for study in their habits is the method

* They also frequent freshly-planted sugar-cane sets, in which the female deposits her eggs; this habit is as yet unrecorded from Honduras.

of egg-laying, which is regulated by the instinct of the insect to place its eggs in a situation where the inactive grub can, upon hatching, get the food it requires.

Whether a tree is selected for egg-laying in preference to others is obviously determined by its condition at that time. As a rule, the act of egg-laying passes unnoticed, and the health of the tree only becomes a subject for inquiry some time later, when the work of the grubs is apparent; and the inquiry is therefore complicated by the necessity for distinguishing between an unhealthy condition occurring as a result of the infestation, and one which may have originally brought it about.

The female is stated to lay her eggs singly, in accordance with the habit of other weevils, by perforating the rind of the tree and depositing an egg in the hole made. The appearance of the eggs and the number laid by each female have not yet been recorded.

It is desirable to know the exact spot selected for oviposition in order that it may be artificially protected. At present the evidence does not place it beyond doubt. It is generally admitted that eggs are not laid in the leaf-stalks nor upon the leaf-spike, when their hard silicious surface is unbroken; and the laying of eggs on the stem is limited below by its maturity, and the consequent presence under the rind of hard wood, for the grub is not a hard-wood feeder, but devours the pithy interior of the stem, and, as before stated, the beetle will not lay its eggs where the young larva cannot get its proper food.

The vulnerable point lies, therefore, about the upper part of the stem, below the attachments of the leaves, and above the woody portion. In young trees, where the wood has hardly begun to form, and the stem is only from one to three feet long, any point above ground is open to attack, and even, according to Mr. Bellamy, below it (28). But fuller evidence is required in support of this statement, which may rest on the erroneous interpretation of observed facts.

In the Commissioners' report, Dr. Gabb states that out of the trees he examined "a large number . . . especially those which "were inclined to one side, or on other protected parts, [*sic*] had the "eggs of the weevil deposited in them near the ground on the under "surface."

Mr. Bellamy says "it lays its eggs in the inequalities of the bark "at or near the surface of the ground" (28).

These are all the particulars about its egg-laying, and no detailed evidence is given in support of them; this ought to be done to prevent subsequent doubt, for, unless the act of oviposition is observed, it is difficult to exclude the possibility of a mistake.

Even though any point between the head of the tree and the ground be equally open to attack in palms grown under perfectly natural conditions, there is in trees trimmed by the planter a weak spot readily available for egg-laying, and one where the majority of eggs are almost certainly laid.

The stout petiole which carries the palm-leaf widens out into a triangular base at its attachment to the stem, so as to overlap its fellow and encircle about one-half the circumference of the trunk; and the space between adjoining leaves is filled up by the coarse matted fibres of the leaf-sheaths. In this way the tender part of the stem is thoroughly protected above the line of attachment of the lowest pair of leaves.

As the leaves grow old they droop and hang down; and to improve the appearance of the plantation and to facilitate riding through it, it is customary to remove the drooping fronds by cutting through the stalks, or tearing them off at the point of attachment to the palm. In this way a portion of stem which forms a ring of about an inch in width between

successive leaves is unduly exposed before the rind is mature. In cocoa-nut palms grown at Kew, this ring is pale, and its rind is tender and easily penetrated at least a year and a half after the protecting leaf-sheaths have been removed. It would harden more quickly in a tropical climate, but, nevertheless, this surface of immature stem is a spot that should be most carefully protected.

In the Commissioners' report, the practice of trimming the leaves is condemned, but a reason is not given, and cannot be inferred from the statements there made about egg-laying.

But in India this fact has been more generally recognised. Mr. Ridley writes about the weevil, "it finds its way to the base of the leaf-"stalk of the palm, and pushes the egg as deeply into the body of the "tree as it can. Some persons affirm that the beetle lays its eggs in "the base of the tree, and that the grubs then burrow upwards. I "have seen no case of this. . . . . I have certainly seen burrows "made by some insect in the old stems of the coco palm, but I do not "believe that they were the work of this animal, but probably of some "Longicorn beetle" (30).

All observers agree in condemning the practice of stripping off the old fronds, which by their leaf-sheaths so thoroughly protect the tenderest part of the stem. The simplest plan of dealing with them is to bend them down without breaking them, or even to tie them up. It is doubtful whether it is sufficient to cut off the fronds at some distance from the stem. If the stalks are not dry the exudation of sap from the cut ends probably attracts the beetles.

The female is also ready to take advantage of any wounds on the surface or cracks in the bark of the tree in which to lay her eggs. Such wounds may be made by other insects, for example in India by the Rhinoceros or Elephant beetle (*Oryctes rhinoceros*, Linn.), in the burrows of which into the head of the palm the weevils take shelter; they may also be caused by unskilful trimming of the leaves and fibrous sheaths, and thus afford another reason for giving up this practice. The cracking of the rind is to a large extent due to the same act which prematurely exposes it.

From the egg the grub, at first minute, hatches and begins to bore into the pith of the tree. An observer should be able to recognise the grub, and distinguish it, even when small, from other larvæ to be found in the palm, those of longicorn beetles and of other weevils especially. In several accounts of grubs being found in trees in various stages of decay, there is nothing to show that they did not belong to some other species of insect.

The larva, or *gru-gru worm* is, when fully grown, about two to three inches long, and of a yellowish-white or brownish-yellow colour. Its body is slightly bent and is very stout in proportion to its length, so that the skin when stripped off is nearly circular.

The head is large and horny, and the mouth is at its lower and anterior part; the jaws, which work, as in all insects, sideways, are short, stout and rather blunt. Its colour is a deep pitchy brown and the jaws are the darkest parts. It is set with a small number of bristles, and there are also a few on the hind segment, while the rest of the surface is hairless. The skin of the body is loose and wrinkled, and, if the underside be looked at, is seen to be thrown into 11 folds, so as to divide the body into 12 rings or segments. These folds are continued round to the upper side, where there is between most of them an additional transverse fold. The body is stoutest at the seventh or eighth segment and tapers sharply from the ninth to the tail.

The skin of the body is somewhat velvety in texture, but that covering the back of the first segment is horny, brown and polished, forming a shield-like protection, and the back and sides of the three following segments present a series of small irregular horny patches; these are the points where the skin, being much rubbed in burrowing, loses its velvety pile and becomes thickened, so as to form callosities, the shape of which depends on the surface wrinkling. The hind segment of the body is also horny and terminates in a flat plate strengthened at the edge with four bristle-bearing tubercles; above it there is a triangular depression with thick raised edges.

Insects breathe by holes or *spiracles* placed at the sides of most of the segments, one pair to each. The grub of the Palm Weevil has but two well-developed pairs, a most remarkable feature; the first pair are to be seen as distinct vertical slits at the lower ends of the horny shield which covers the back of the first segment, the last pair on the inner margin of the thick raised edges above the tail-plate are also conspicuous. (*See* VI.) Legs are only represented, if at all, by six small tubercles on the underside of the three first segments.

The shape of the hind segment, the position of the two pairs of well-developed spiracles and the large size of the full-grown larva, will probably distinguish the grub of the Palm Weevil from that of any other species, except a very few most nearly allied to it and of similar habits.

The boring of the grubs is said to be upwards, a statement that Mr. Ridley contests. They feed on the soft pith that fills the inside of the stem up to the growing point, and can be found in any part of it. The tree is killed by their feeding at the base of the cabbage and injuring the growing point, whereas damage done to the pith in the lower part of the stem does not necessarily prove fatal. There is some confusion as to their feeding in the head of the tree or not, due partly to the larvæ of other insects being mistaken for them, partly to a loose use of the term "cabbage," the limits of which are not taken to be the same by different observers. It is the pith immediately below the true cabbage that appears to form their favourite source of food. The grub in boring makes a tunnel corresponding to the diameter of its body and becoming larger as the latter increases in size. It does not make holes on the outside of the trunk which can serve as a conspicuous sign of its presence. When approaching maturity it returns to the outside of the tree, according to Dr. Gabb, by enlarging the channel along which it has come, a process that must necessitate its turning round in its tunnel. Arriving near the outside, it eats away the inner rind so as to leave a thin shell, "of "the thickness of foolscap paper," between it and the outer air, through which shell the beetle can easily break. It then retreats a little way and constructs a close oval cocoon of the fibres surrounding the pith, that is, of the fibro-vascular bundles running to the fronds. This cocoon is three or more inches long and about one and a half in diameter, and consists of a dense mass of interlacing fibres, mostly arranged circularly and suggesting a bird's nest. No gum or silk is employed in the cocoon, within which the grub casts its skin for the last time, and appears as a *pupa*.

The *pupa*, perfectly harmless—for it takes no food and cannot quit the cocoon—has a general likeness to the beetle to which it changes. It is light-coloured with a thin delicate skin; the snout, antennæ, legs and wings are neatly and symmetrically folded on the underside, the snout extending along the middle of the body, the two anterior pairs of legs doubled up and covering the wing-cases and wings. These are shorter than in the mature insect and lie over the hind legs, the wings

projecting beyond the wing cases. The upper side of the abdomen is exposed and its spiracles are now conspicuous.

Under the investing skin of the pupa the beetle slowly develops its organs, and at last splits it and emerges. Soft and pale, it does not leave the tree at once, but waits until its integuments have hardened and have acquired their full colour. Then it breaks through the rind which shelters it and comes out as an adult weevil. A certain number are unable to escape from different causes and perish in the tree.

The holes made by the exit of beetles are conspicuous, and may afford the careless observer the first clear sign of the mischief that is going on. They occur anywhere in the soft part of the palm stem, and most frequently just below the head. Cocoons are not to be found in the cabbage, but only close to the outside in the neighbourhood of the fibre from which they are made.

The length of life of the perfect weevil and the time passed in the early stages have not been ascertained, nor have the periods at which egg-laying is performed. These points are less important in tropical than in temperate countries, where the life-periods of an insect are closely related to seasonal change. But in the tropics the dry and wet seasons, at least, influence the stages of insect-life, and an effort should be made to obtain accurate knowledge of matters which are of so great importance. Prevention of egg-laying for example is likely to be more successful if carried out in reference to the seasons of oviposition, should any such exist.

The Palmetto Weevil of the Gulf States of North America (a feeder on *Sabal Palmetto*) is said by Summers (13) to emerge as a perfect insect in September and October, to live through the winter and lay eggs in the early summer, the grubs being found in the latter part of June and July. Adult weevils are usually long-lived, and it is possible that the Palm Weevil lives nearly a year as a perfect insect.

Mr. Hunter believes that there is more than one brood a year, which is probable, and specimens in all stages are said to have been taken from the same tree (26). This would show that seasonal development is not well marked, but the observer may have been mistaken as to the identity of some of the younger specimens found.

IV.—Economic Features of the Palm Weevil.

In the preceding pages the appearance, habits and life history of this insect have alone been described. It is now necessary to discuss the economic questions involved, the appearance of the injured trees and the extent of the damage inflicted, the circumstances which favour the Weevil's destructiveness and those that tend to limit it.

The American Palm Weevil feeds on several kinds of palm, probably on almost any kind, particularly of the soft-stemmed palms; among the species it is known to attack are the Cocoa-nut palm (*Cocos nucifera*), the Cohoon palm (*Attalea Cohune*), the Cabbage palm (*Oreodoxa oleracea*), the Big Thatch palm (*Sabal umbraculifera*) and the Macaw Tree or Gru-gru palm (*Acrocomia sclerocarpa*).

It also attacks sugar-cane. Its range extends from South California over Central and South America as far as Brazil, and it is found in the West Indian Islands. The Indian species occurs throughout the Oriental region of naturalists (India, Borneo, Java, &c.), and is also a general feeder on palms, particularly on the Cocoa-nut palm and the Toddy-tree (*Phœnix sylvestris*) (35).

The range of the cocoa-nut palm is therefore wider than that of either insect, and being largely independent of human agency is so extensive—while its original home, which De Candolle finally considered as being in the Old World, is so doubtful—that it is now impossible to speculate on the length of time that the tree and either species of weevil have been in association. But whether it has always served as food for the American Palm Weevil or not, it is now perfectly clear that the insect is not dependent on that tree alone, and that *its extirpation could not be effected in Honduras by cutting down and destroying every single cocoa-nut palm in the colony.*

Honduras possesses as large if not a larger variety and number of palms than perhaps any other region where the cocoa-nut is cultivated, and the greater proportion of the country is in a wild state and cannot be dealt with by any economic measures; there, at all events, it would appear that the natural food of the insect consists of wild palms, from which its attention has been diverted to the cocoa-nut plantations.

Of these wild species the chief is the common Cohoon or Corozo palm, which does not grow in the same situations as the cocoa-nut tree, but in the rich alluvial soil of the Corozal, or cohoon ridges. These ridges are really depressions between the series of quartz elevations running more or less at right angles to the seaboard.

The cocoa-nut, a lover of sandy soil near the coast, is grown in plantations as a rule not nearer than five or six miles to the cohoon ridges, but which in some cases lie close to them. The land of the ridges is valued for banana growing, and for this purpose, and not for growing cocoa-nuts for which the soil is unsuitable, the cohoon and other palms have been extensively felled and allowed to lie upon the ground; this has resulted in a large increase in the numbers of the weevils, which have bred in the felled trunks. As long as they are feeding on wild plants they are not likely to multiply fast, because a balance will have established itself between the rate of increase of the trees and the causes tending to diminish the number of the beetles on the one hand, and the rate of propagation and destructiveness of the latter on the other hand—otherwise beetles or palms must gradually die out; and observers in Jamaica and India have noticed that the number of wild palms is not sensibly affected by the presence of the weevils.

But if this balance is disturbed by external causes such as the cutting of cohoon palms, which favour the weevils, a large increase in their numbers will result.

There is good reason for supposing that the extensive injury to cocoa-nut plantations is largely due to the swarms of weevils thus bred. In the Commissioners' report, Mr. Baber in his evidence states that he considers the proximity of a cohoon ridge to be a source of danger; and Mr. Hunter has informed the writer that little was known of the beetle until about 1888, a period which coincided with wholesale felling of cohoon palms in order to bring the ridges under cultivation.

As there is a particular age when the cocoa-nut becomes liable to attack, namely, at the time of its first bearing, between four and six years old, it is possible that there is merely a coincidence in time and no further connexion between the clearing of the ridge and the damage done to the palms on their approach to maturity. Mr. Schofield, however, states that among some 2,000 trees planted about seven or eight years previously only a few isolated cases of disease had appeared until the end of 1888, "some five trees altogether having succumbed to the attacks of "the bug" (26). This tends to negative the idea of a coincidence, for the

majority of his trees must have reached maturity without being immediately attacked.

If the development of weevils has been thus encouraged, it will be difficult to check it by the destruction of the felled cohoon palms. Wild palms are so abundant that the removal of them, living and dead, is impracticable, and the interest of the banana planter on the cohoon ridge do not necessarily coincide with those of the cocoa-nut planter, so that he cannot be expected to go to the expense of destroying felled palms which do him no harm. The cohoon palm is a soft pithy tree that will not readily burn, even if that be the proper method of preventing beetles breeding in it. The destruction of felled palms will be considered later.

It is doubtful whether cocoa-nut plantations should be established at all in the immediate proximity of the cohoon ridges, and it is important that the amount of injury sustained by cocals at different distances from them shall be carefully compared, as this question must arise in the establishment of further plantations.

Mr. D. Morris, F.L.S., of Kew, made, when Director of the Botanic Gardens in Jamaica, some very important observations bearing directly on this point which it is desirable to quote in full (20) :—

"It has been remarked as somewhat strange that while the cocoa-nut palm grows freely everywhere along the coast of Jamaica, it is almost entirely absent from Alligator Pond to Black River, and, indeed, along the southern coast as far as Savannah-le-Mar. At first this was taken as an accidental circumstance, but careful inquiry on the spot has convinced me that although the soil and climate differ very slightly from those in other portions of the island where the cocoa-nut thrives luxuriantly, all efforts to establish it along the seaboard of the parish of St. Elizabeth, and especially in the Pedro district, have signally failed. The plants appear to thrive for a few years and to grow remarkably well, but before coming into bearing [or soon after] they suddenly die off from the top, leaving nothing but a bare frondless stem. After examining several trunks of the Big Thatch (*Sabal umbraculifera*), a palm which is very abundant in the district, and finding them completely riddled by the attacks of the larva of a beetle very closely allied, if not identical, with the destructive palm beetle of the East Indies, I came to the conclusion that one, if not the chief cause of the absence of the cocoa-nut palm was the abundance of this beetle. Further information and inquiry into the neighbourhood have fully confirmed this view. The Big Thatch appears to exist, and, indeed, to thrive luxuriantly in spite of the beetle, but the cocoa-nut fails. The terminal bud of the latter offers an easily accessible and tempting *bonne bouche* to the larva, and it succumbs to its attacks. On the other hand the Big Thatch thrives and covers the country.

"It seems as if in this instance a choice must be made between the Big Thatch and the cocoa-nut palm. The work of exterminating the former palm, covering several thousand acres, is an alternative which is neither practicable nor, for some reasons, is it indeed desirable. If the ravages of the beetle do not extend to other portions of the island it would, perhaps, be better to accept the inevitable and devote attention in this district to other plants of a more promising and remunerative character."

As before mentioned the palm does not prove attractive to the beetle till it begins to come into bearing at an age from four to seven years, when the terminal bud becomes larger and more juicy. At this period the tree has some three feet of stem, and it remains liable to attack until it is about 12 years old and has some 12 or 14 feet of stem. If it is free up to that age it is rarely attacked afterwards. The greatest damage

takes place from the middle to the end of the dry season, that is, about July to September, and perhaps corresponds to a period of egg-laying at the beginning of the season. It has been stated of the Indian weevil (33), "insects of the above class multiply rapidly in times of protracted "drought, and it is during such periods of abnormal weather that they "commit the greatest amount of mischief."

An infested tree shows at first little or no signs of injury, unless the points at which eggs are laid are discoverable by a skilful observer. The Commissioners' report says that "by careful observation small "holes may be discovered with a little gum oozing from them, but by "that time the larvæ have attained considerable size and have eaten "their way far into the heart of the tree" (26). Mr. Ridley says of the Indian weevil :—"It works entirely inside the tree, and makes little or "no external marks. By listening at the side of the tree the grub can "be heard gnawing the wood. But usually the withering and fall of "the central shoot is the first sign that anything is wrong. In some "cases a tree exudes a shiny liquid, having an unpleasant sour smell, "which is a sign of serious damage "(30). To listen for the grub feeding may be more practical than it sounds; the ear should be placed against the tree, or against the end of a piece of seasoned deal, used like a stethoscope, with its other end on the trunk. Another account of the same insect, evidently from the pen of a careful observer, states that "if "the heads of the trees are frequently inspected by skilful beetle "searchers many trees may be saved by cutting out the grubs, their "presence being known by the searcher either finding a cocoon in "the tree or, more generally, by noticing slight wounds on the smooth "skin (if I might call it so) of the leaf spike, which are unintentionally "made by the grub in eating the soft pithy mass through which it "pushes its way" (27).

The origin of the small holes exuding gum, to which the Commissioners refer, is not clear, unless they are due to the grub having accidentally broken through the rind at that point. That the larvæ do occasionally penetrate the rind slightly is shown from the last account quoted, and from the good effects which sometimes at least have been found to follow the application of salt or lime to the head of the trees, which presumably acts by reaching the grubs through wounds in the silicious surface. There is just a possibility of the small holes being made by other insects attracted to a sickly tree ; and this point and the character of the external signs of injury, are worthy the attention of a naturalist who has had previous experience of the work of internal-feeding insects. Mr. Hickey mentions that after a rainy spell of a few days he has noticed a golden-coloured glue or sap running out of some of the trees, but he failed to find any borers in them (32). The whole matter deserves more complete investigation.

As the burrows of the grubs progress, and the vital part of the tree is reached, the fronds become discoloured and droop, and it is said that they turn red in a tree attacked by weevils, and yellow in one dying from other causes. The fact if true is important, and may be due to the drying up of the leaves from the loss of sap caused by the severing of the fibro-vascular bundles which supply them. The fronds and head die, sometimes from the first attack, sometimes from later ones, and the whole crown falls off leaving a leafless stump. The soft tissues of the head and trunk decompose and are filled with grubs, not only of the Palm Weevil but of other kinds of insects.

Mr. Schofield, on cutting open such a tree, "discovered two "large maggots, together with an enormous quantity of smaller "maggots of white appearance, and about $\frac{3}{4}$ to 1 inch in length. The

" inside of the tree was completely rotten and stank, presenting the " appearance of fresh dung or manure "(26). There is nothing to show to what species these maggots belonged.

The beetles will lay their eggs in felled trees, and the grubs continue to feed in them, at least so long as there is undecomposed pith for them to consume, and in this way a dead tree will continue to breed beetles for some time. But weevils are not as a rule attracted to vegetable matter that is far advanced in decay, and particulars are required of the length of time that a felled trunk will continue to attract the parents, and to serve as a place of growth for the larva of this particular insect.

Mr. Hickey says, " I cut down a small cohoon tree, very much " resembling the cocoa-nut palm, cutting it through the tender portion, " the bud. In two or three days it began to sour, and for a few " evenings, between sunset and dark, I noticed several of these beetles " fly to it and bury themselves an inch or more in the soft pulp, some " remaining there all day. In about 10 days they were all gone. A " month later I cut the stump off about 3 feet lower down and found it " full of holes, and some 10 or 12 worms the size of a man's thumb, " 1½ inches long, with a short hard head, resembling very much the " common grub worm "(32). It follows from this readiness of the insect to breed in stumps and fallen trees that the practice of cutting down injured palms at the height of 3 feet from the ground, and neglecting the stumps, is admirably calculated to increase the mischief, and on this point the evidence of Mr. Baber to the Commissioners may be given: " He saw no sign of damage on Long Reach Sittee until he " began thinning; the trees had been too thickly planted. When " thinning he left the fallen trees lying in the plantation, and considers " that they were or might have been a source of attraction to the " weevils, and that they ought to have been removed or destroyed. " The trees were about five years old when he thinned them, and very " soon after he noticed signs of their being attacked; in about four " years he lost fully 1,000 trees out of a plantation of 2,500; during " that time he was constantly cutting down and destroying trees " (26).

Mr. Phillips says, " The plan I adopted was to cut the tree " down to about 3 feet off the ground as soon as it showed any signs " of being attacked by the weevil, but the leaving of the stump in the " ground added to the danger of infection rather than diminishing it"(26).

The destruction of trees on Mr. Baber's plantation amounted to nearly 40 per cent., that on Mr. Phillips's to about 30 per cent. (1,000 out of 3,500). Other owners have lost equally large numbers. But the amount of injury has not been uniform over the different plantations; Mr. Baber believed that although the weevil was abundant in Sittee River, they had not affected his plantations at Serango Bight or False Sittee at the mouth of the river.

To what this irregular distribution of the attack is due, whether to the varying distance of a cohoon ridge, or to causes affecting the health of the trees, can only be ascertained on the spot. It is noticeable that, according to Mr. Hickey, there are old cocoa-nut groves in Florida the owners of which have had no experience with these borers, and know nothing of them, and the same thing occurs in Asia where the " red beetle " is said to be rare in Penang, and unknown to many planters, though common in Malacca and Singapore.

Now whenever a case of insect injury to trees is investigated, one circumstance is always put forward as a factor in bringing about the infestation: that the trees are in a low state of health. It is constantly

disputed, but it turns up so regularly and is so often urged by persons who have only the facts and no previous experience of such economic questions to guide them, that it is impossible to escape from the duty of giving it careful consideration in every case. The present attack is no exception, and the point is raised in the Commissioners' report, to be summarily dismissed. Insects are well known to prefer as a rule an unhealthy plant to one that is sound, and the only questions for consideration are whether any given insect is equally ready to attack trees irrespective of their state of health, and whether any given case of excessive insect injury is traceable in greater or less degree to a previously unsound condition of the host-plants.

V.—Fever.

The cocoa-nut palms of Honduras appear also to suffer from disease, and disease of an obscure kind not due to insects. It is known as "*fever*," and at present no accurate account has been given of its symptoms, nor of its prevalence, so that it cannot yet be accepted as a cause of the weevils' increase, but it must be taken merely as a hypothesis to be inquired into. From the little known about it, it appears to be allied to one or other of the diseases (if, indeed, they are not the same) observed in Demerara in 1875–6, and in Montego Bay, Jamaica, in 1891. Attention has been called to it in Honduras in a recent communication by Mr. Seay to the Colonial Office, of which the writer has only seen an abstract. According to Mr. Hunter, 50 to 80 per cent. of the trees attacked by the weevil show signs of the disease at the top first. This may be merely a misinterpretation of the early signs of injury due to weevil-grubs before they have been noticed in the trunk, but the statement is of importance and should be confirmed or refuted. In his evidence, Mr. Baber says he "has a small spot on the sea-side in "Serango Bight (very swampy). He there noticed that the trees died off "very rapidly, although of various ages from seven to ten years. Does "not know the cause of death : some trees on better land close by were "not affected" (26). Mr. Schofield states that his plantation was apparently healthy on the 24th December. No tree or plant showed any signs of sickness. The hands went away for the Christmas holidays, and its condition was not observed during the next few days. On the 7th of January he discovered some 15 trees more or less affected, some had actually fallen over, others had their fronds broken and trailing on the ground, while the rest from their yellow and drooping appearance showed plainly that they also were diseased. Commenting on this, he says, "it seems generally thought that it [the weevil] will not "attack a plant unless that plant is in an unhealthy condition. How "then is its presence to be accounted for in trees that only two weeks "ago were perfectly healthy?" (26)

As it is out of the question to suppose that weevil grubs developed from eggs laid after the 24th of December so as to cause such serious mischief, it is clear that the attack must have started some time before, and that its early stages were overlooked. The fact that no disease was noticed does not go for anything, unless special and thorough examination was made of the health of the trees afterwards found to be attacked, a very different thing from mere non-observance of unsuspected mischief.

The accounts of the disease in Demerara are not of much assistance, because very little light was thrown on the cause. It has been described by the Hon. William Russell, who, in investigating it, was careful to distinguish between it and the work of different

species of insects. He says of it that "healthy fine trees in full bearing commence to fail in a few weeks; all the leaves fall down, and the centre falls off. No beetle or worm is to be found; the disease seems more like what is known as plantain disease"(14). In a pamphlet published at Georgetown and not generally accessible, he gives the following account:—"My first dissection of a tree diseased from blight led me to suppose that the cause of the disease was the attack of the weevil in question [presumably the Palm Weevil, though not mentioned by name]. The part of the stem immediately under the cabbage portion was completely riddled by this insect, and hundreds of grubs, in all stages of development, were found. . . . . On dissecting the top of the tree, all the fruit germs were found quite rotten (putrid fermentation), and gave a most offensive smell, and at the point where the last frond or central spike divides from the lower fronds, the state of putrefaction was fearful. Fortunately, I decided upon trying another tree. This time the stem was perfectly sound, and without a speck; but on dissecting upwards, and carefully removing each frond and its integuments, the outer part was found to be more or less tainted, and the fruit stalk from which the fruit had fallen was quite offensive. As the top of the tree was approached the fruit germs became more and more rotten; still, on the integuments of each frond being removed, the cabbage in the centre was quite sound, so that I could eat the centre to within six inches of the diseased point, which, when reached, was quite as putrid as my first specimen. The crimped form of the bottom of this central spire left no doubt on my mind that the seat of the disease was at that spot, and that there had been abundance of vitality in the lower part of the tree to send forth the central shoot until the parts immediately in contact with the putrid matter were poisoned by it. A careful examination was made of this and various other subjects without finding a trace of an insect, even with the aid of a powerful magnifier, and afterwards under the microscope. One small beetle was found on one subject which is before you, and was named by my friend, Dr. Whitlock, as *Papalus tridens*. . . . . Seeing that only one specimen of this diminutive beetle was found in my many investigations, I can scarcely believe that the disease can be attributable to it"(15). What insect is meant is not clear. The generic name is obviously a misprint for *Passalus*, but *Passalus* (*Eriocnemis*) *tridens*, Wied. is a native of Malacca, &c. The *Passali* lay their eggs in decayed wood, and are harmless. Specimens of the diseased trees, preserved and sent to Kew, were carefully examined by Dr. M. C. Cooke for injurious fungi. His search resulted in the description of several new species, but he could not find one that appeared to be the true cause of the disease. Since 1876 the study of disease-producing fungi has made great strides, and that of bacteria has been almost entirely created; and it is possible that a similar thorough examination would now yield different results. The treatment then adopted was excision of the diseased parts, washing with clean water, and dressing with caustic lime. No results are given. Mr. Russell was positive that the disease was infectious and spread to windward, and was most virulent where the trees were planted close, three rods each way.

Mr. W. Fawcett, F.L.S., Director of the Botanical Department, Jamaica, has examined into the cocoa-nut palm disease at Montego Bay, Jamaica, and his report in the *Bulletin* of the Botanical Department, which it is also advisable to give in full, is as follows:—

"Several trees were cut down, and the roots, stem, leaves, and cabbage examined. There was no evidence whatever of attacks by a beetle;

there were some small larvæ, some wood lice, earwigs, ants of several species, and other insects on the affected parts, but they were evidently only preying on the diseased juices, and were not the cause of the disease.

"The roots were quite sound, and the stem appeared to be unaffected. Both stem and leaves were of normal size, and there was no indication of a gradual dwindling of vitality due to lack of proper nourishment extending over a long period. The disease, whatever it might be, seemed to be quick in destruction.

"The youngest parts were those affected. The leaves and flowers in the bud were sometimes able, though affected, to withstand the disease so far as to open out, and some leaves and nuts attained almost their full development before the tree succumbed. In the case of tall trees, the first indication of the disease was the dropping of the young fruit. It was stated that the disease in this condition had been checked by setting fire to the fibrous material at the base of the leaves, which process burnt all the leaves; new fronds, however, developed, and the trees were, at any rate for the time, saved. The application of salt to the cabbage had also, it was alleged, been successful.

"In almost all the trees examined the sour smell of a putrefactive fermentation was very noticeable, and I am of the opinion that the disease is due to an organised ferment, which is able to attack the very tender tissues of the youngest parts, even outside the terminal bud. If this ferment can be destroyed by fire or other means before it reaches the terminal bud in the heart of the cabbage, the tree may be saved.

"Any remedy should therefore be applied on the very first signs of disease. If delayed too long until the terminal bud is diseased, the tree cannot be saved.

"Although to fire the fibre at the base of the leaves is easy of application, it is not safe near buildings, and by the destruction of the leaves the production of fruit is for a long time retarded, with consequent loss.

"I would recommend that those who do not care to apply fire should drench the cabbage with a solution of sulphate of iron in water, in the proportion of 2 lbs. of sulphate to 1 gallon of water. A solution of sulphate of copper might also be tried in the proportion of 5 parts to 100 of water and a solution of boracic acid in the proportion of 4 parts to 100 of water.

"All diseased trees which cannot be saved should be cut down and burnt, to prevent infection. In order to give the tree every chance of recovery, the soil might be scraped away from the roots and the ashes of the burnt trees applied, together with some manure.

"It may be said that these remedial experiments are costly, but, on the other hand, the annual value of each tree is stated to be at least 4*s*." (33).

In a later number a correspondent writes:—

"I have not as yet tried the sulphate of iron remedy. I have continued the application of salt and have kept to the firing of the trees, and as far as I can judge at present I consider the last-named remedy good, if the trees are not too far gone when fired. A good number that were fired last year are now bearing fruit. The trees do not recover naturally, and the disease is certainly spreading" (34).

These facts and methods of treatment should be studied by planters in British Honduras; for in the event of disease being proved to occur, suitable steps must be taken to check its increase as well as that of the weevil. But whether the latter is encouraged by the presence of diseased trees or not, no relaxation of the measures taken against it should be permitted.

VI.—Other Insects.

Another question for consideration is the possibility of other kinds of insects aiding or preceding the weevil in its work of destruction. There is no evidence whatever that such is the case in Honduras, if we except another species of weevil, but it is not so elsewhere.

The Indian weevil shares its responsibility with two other beetles, *Xylotrupes gideon*, Linn., and *Oryctes rhinoceros*, Linn., both quite distinct in appearance and allied to the chafers. The latter, the Rhinoceros, Elephant or "black beetle" of the Indian planter, is a stout cylindrical insect about 2½ inches long; the head has no snout whatever, but is short and broad with small clubbed antennæ, whose ends are formed of several flat plates placed side by side. Between the eyes is a fixed horn, like that of the rhinoceros, large in the male, small in the female. The legs are very strong, with stout shanks set on the outer edge with three teeth, and five-jointed feet.

The grubs are large, soft and curved, *with six stout legs* and a baggy hinder end; they are harmless, and live in heaps of rotting vegetable matter or the manure-like inside of decayed palm trees. The beetles are the destroyers, and attack the palm at night, boring in at the base of the leaf-stalks till they reach the cabbage, thus forming holes which attract the weevils. They bite through the young folded leaves which become characteristically ragged, and may kill the tree by injuring the bud.

Treatment consists in the removal or destruction of the heaps of rotting matter in which they breed, and in extracting the beetles from the holes in the trees with a barbed wire or "beetle spear."

These two insects are not natives of America, but many allied species are there common.

The Hon. W. Russell has described the ravages in Demerara of the Elephant beetle on palms (15). The insect referred to is probably *Megasoma actæon*, Linn., as Dr. Sharp, F.R.S., has kindly informed the writer. A similar species, *Megasoma elephas*, Fabr., occurs in Honduras, and is an enormous insect, some 4½ inches long in the male and 2 inches broad. It is stout and square, black in colour, but densely covered with a fine brown pile. The head in the male is prolonged into a long horn with a forked tip, which is turned up and is not, as in the weevil, a snout with its mouth at the end; there is a shorter horn behind and two on the shoulders. The legs are very stout, and the shanks spined.

The Elephant beetle, according to Mr. Russell, burrows into the earth at the roots of young trees. It makes small holes "like crab holes," and works its way down until the blanched part of the palm is reached, when it feeds on the cabbage, and lays its eggs in the fibrous part, which it teases out. The central spike dies away, and the first sign is a crimped appearance of the fronds. The beetles were got rid of by paying a small sum to labourers to search for them, and by protecting the lower part of the stem with lime, cinders, or rank oil (15).

Other enemies are gregarious caterpillars, scale insects, and a very small white-winged fly, *Aleurodes cocois*, Curtis (8, 11), all of which infest the leaves. For the latter syringing with kerosene emulsion would be the proper means to adopt.

As before stated, none of these have yet been observed in Honduras. The consignment of weevils recently sent to Kew included two examples of a well-known kind, *Rhina barbirostris*, Fabr., which may be called the *Bearded Weevil*. This insect resembles the Palm Weevil in its

general plan of structure, but it differs in the following points: It has a straight snout, with the mouth in front of it and not below, the jaws being hooked outwards and distinctly visible. The horns are long, with a slender club, and are inserted in the middle of the snout. The eyes almost meet above, being only separated by a very narrow ridge. The wing cases extend to the tip of the body.

The peculiar and characteristic shape of this insect (Pl. II. 1) will distinguish it without further description. In the male the snout is longer and stouter than in the female, and its anterior half, as well as the breast, is covered with a dense yellow down.

The grub of an allied species, *Rhina nigra*, Drury, has been figured by Coquerel, who found it abundant in the decayed interior of a screw-pine (*Pandanus utilis*) in Madagascar (10).

The writer knows of no other description of the habits or economy of any species of *Rhina*. Possibly some of the smaller grubs so frequently found in the stem or the rotting cabbage of decayed palms are those of the Bearded Weevil.

Nothing much is known of causes which check the weevil's increase. It appears to be favoured by an unusually dry season, and is presumably checked to some extent by a wet one. The animals, birds and insects which attack it have yet to be identified. Ants seem to prey on it, and reference to this fact will be found in the next chapter.

Attention is drawn to the following points, as being likely to repay further attentive observations made to determine them:—

1. The spots usually selected for egg-laying in wounded and in sound trees, care being taken not to mistake the work of any other insect for that of the weevil. As oviposition probably takes place at night, it will be worth while to make observations at that time.

2. The length of time passed in each of the different stages, of the number of broods in the year, and of the periods when the majority of the insects emerge, and when they lay eggs. The two latter, as has been shown for the Palmetto Weevil, do not necessarily coincide.

3. The length of time that a felled tree will serve as a source of attraction and a breeding place for beetles, and the earliest symptoms of their presence shown by an infested palm.

4. The relation between the situation of the infested plantations and the cohoon ridges or other districts abounding in wild palms.

5. The preceding state of health of injured trees, with special reference to the character of the soil, drainage &c., and the occurrence of the so-called "fever" or other disease.

6. The species and habits of other insects which may be associated with the Palm Weevil in the work of destruction.

7. The natural checks upon the weevil's increase; the effects of weather; the presence of insectivorous animals.

It is necessary to distinguish between the sexes in observations on the weevils when egg-laying, or attracted to baits, &c.; and between their grubs and those of other insects. The females alone are of importance and require to be caught.

VII.—Methods of Treatment.

To a certain extent, reference has been made to measures adopted against the ravages of the Palm Weevil. It is now necessary to discuss them in detail, and in so doing to keep in mind the ascertained facts of its life-history, and the records of this and similar infestations. These measures will be found, as usual, to fall under two heads, those designed

to prevent attack upon trees hitherto untouched, and those intended to save injured plants. The former are more important, for the latter in the opinion of many experienced men do not exist.

1. *Methods of Growth and Cultivation.*

Care should be taken in the choice of sites for new plantations, and special attention paid to the avoidance of undue proximity to a cohoon ridge. Drainage should be thorough, for the trees have been observed to suffer in swampy ground. They should not be planted too close; every occasion of felling a tree in order to thin out a plantation affords a source of attraction to the weevils, and imposes a consequent necessity for destroying the felled trees and stumps that they may not serve as breeding-places. Moreover the spread of any infectious disease is materially assisted by close planting. How far it is expedient or possible to grow the trees in small plantations separated from each other by a belt or intervening plantation of trees, in which wild palms do not occur, the writer does not know, but it is an invariable rule that very large plantations are particularly favourable to the spread and multiplication of any insect that has established itself in them.

2. *Prevention of Egg-laying.*

The trees should be left as far as possible in the natural state, and unnecessary trimming either of fronds or of the fibre avoided. It may be necessary to tie up the older fronds, and if they must be removed the stalk should be cut through sufficiently far from the stem to leave the sheathing base intact. It may be advisable to tar the cut stump if it is found to attract beetles. The value of leaving the trees alone is shown by a passage in Ferguson's *All about the Coco-nut Palm*, which is also quoted by Ridley :—"Scores of instances might be recorded "where, till the trees were come into bearing, a red beetle was never "seen, but, no sooner was the land cleared and the trees trimmed, than "it made its appearance and became very destructive. On one pro- "perty the trimming system had been carried on for years till, indeed, "more than one-third of the original plants perished, before the estate "was ten years old, and they were going at the rate of three trees "weekly. The work of trimming was stopped for the reasons offered "above; the loss of trees continued for some time afterwards, but at "the end of six months it had entirely ceased. On another property "beetle men had been employed for ten years, and trees were being con- "stantly lost; from the day that the beetlers were discontinued two "trees perished within the month, and not another was lost in the sub- "sequent seven years" (22). And W. B. L. writes in the *Tropical Agriculturist* to the same effect :—"The red-beetle [*Rhynchophorus* "*ferrugineus*] cannot penetrate the leaf imbrication, and, when the "older ones decay in the course of nature, the stem has become too "hard for its operations. A tree here and there may be lost from "an accidental wound or from some defect in the fitting of the leaf "sheaths, but it is only where the good taste of the planter has im- "pelled him to trim the leaves that any serious damage has been done "to a field. All the leaves should be left on the tree till nature dis- "poses of them at her own time and in her own way. Nothing that "can be done to a cocoa-nut tree above ground can be anything but "injurious" (21).

All wounds, whether made by accident or by insects, on the soft part of the stem, leaf sheaths or spike should be at once dressed with a dab

of tar mixed with fine sand. Holes should be probed with a "beetle spear" or hooked wire to extract insects which may have caused them, and then plugged with a tuft of fibre or dry grass dipped in tar.

The parts selected for egg-laying on the stem may be plastered with lime-wash, to which, when cold, there may be added, as an experiment, a small quantity of Paris-green (a deadly arsenical poison).

Tarring the stem will probably keep off the beetles, but should be tried with great caution till its effects on the tree have been ascertained. Mr. C. T. Hunter states that he has kept away the beetles by pouring tar on the leaf-spike and the leaf sheaths; he claims for this method that it does not injure the tree and that the effects of it last for some three years. Application of tar to the leaf sheaths would probably do no harm, but may not be necessary if they themselves afford sufficient protection by being left intact. It might, however, lessen any possibility of beetles creeping in to oviposit between loosely fitting sheaths. Such a remedy ought only to be tried on a small number of trees, so that the loss may not be felt if it proves injurious. Most disastrous results have before now followed the application on a large scale of an untested method of treatment to plants. Coatings of moist clay have been found useful in similar circumstances, and a composition which has met with success in Germany is Leinweber's, and is thus prepared: Five pounds of coarse tobacco are infused in a bucket half full of boiling water and allowed to stand for 24 hours. The vessel is then filled with ox-blood and one part of slacked lime and sixteen of fresh cow-dung are added (quantity not stated). These are well mixed and allowed to ferment for two or three days in an open tub, and then applied to the parts requiring protection. It is particularly well suited for the lower parts of the stem.

It is not supposed that the above mixture can be successfully employed in Honduras, but it is given as an example of the class of compositions found to be of service.

Coarse soaps and rank oils (whale oil) have also been of use.

3. *Destruction of Injured Trees.*

This treatment is the one most generally recommended, but it requires caution.

An attacked tree should not be hastily cut before there are unmistakable signs, by the withering of the leaves and spike, that it is doomed. About the possibility of saving injured trees there is much dispute, but a certain number do survive the first attack, especially if low down in the stem, and in India it is found practicable to attempt their cure.

It is useless to cut down any infested tree, unless proper steps are taken to treat it when felled so as to make it unsuitable as a breeding-place. In fact it will be probably less harmful if left standing than if felled and neglected.

To the reckless felling and subsequent neglect of injured trees is to be attributed much of the recent increase in the insects' numbers. On some estates trees have been regularly cut down for several years, and the damage has gone on growing, and it is possible in this way to cut down an entire plantation without getting rid of the beetles. No tree therefore should be cut unless it can be properly handled. When its destruction is decided on it should be either grubbed up or cut off close to the ground; the stump will then serve as a bait to attract weevils, or it may be buried under a heap of earth. On no account should a tree be cut off so high as to leave a tall stump standing.

Perhaps the best way, when practicable, of dealing with felled palms is to sink them under water. Burial in sand has been recommended, and will possibly suffice, but it will not prevent the development of grubs already in the tree, and the subsequent emergence of the weevils, if, as is asserted, they are able to burrow.

Burning is objectionable, because the parts which the grubs inhabit are too soft to burn. Dr. Gabb found healthy larvæ in a tree that had been subjected to burning, and according to Summers, the grubs of the Palmetto Weevil are more partial to the older and more injured plants, particularly to those which have been burnt.

A good method of dealing with felled trees is the following: split them open lengthways so as to expose the soft parts, and extract all grubs or beetles found; visit the trees daily and collect the weevils attracted to them; as the surface dries split them again, so as to expose a fresh moist surface, and continue the capture of beetles and the splitting, till the tree is too dry to prove attractive. When the tree has been thus thoroughly hacked up and dried by degrees it will probably be found to burn easily. As it will take some time for the eggs laid by the weevils which visit them to reach maturity, no fear need be felt about their breeding fresh swarms, provided that they are not allowed to lie too long. Other insects will lay their eggs in the exposed tissues, but their grubs may be neglected, if a look-out is kept against the development in this way of species that are not at present regarded as important. Supposing that it takes six weeks for the weevil to mature, and the period is probably much longer, no eggs laid after the tree is felled will produce beetles if destruction is completed within that time. Of course half-grown grubs overlooked in the tree may mature sooner.

Cohoon and other palms felled in the neighbourhood of cocals ought to be similarly treated, and not allowed to lie and infect the neighbourhood.

4. *Capture of the Weevils.*

This plan has also been generally recommended, and is in some ways preferable to the last. It is attended with no destruction of trees, and is applicable to plantations which have not yet become seriously infested, whereas the felling of palms can only be resorted to when they are already injured.

There are three ways of taking the perfect insects: on the wing or when crawling about; when lurking in the crevices of the leaf-sheaths and fibre; when attracted to baits.

The best way—that by which the greatest number can be caught with the least labour—is the last. It has been mentioned in the preceding section that the stumps and soft tissues—the split cabbage—of felled palms are most suitable for this purpose, because the weevils are attracted in large numbers to the fermenting sap, and can be easily collected. It has been proposed to sprinkle the stumps with Paris-green to kill the weevils visiting them. The experiment may be tried, but will possibly defeat its object, because arsenic is an antiseptic and may check the fermentation of the sap and its attractive odour. The beetles can be collected into buckets and killed with boiling water. If they are apt to escape from the buckets these should be furnished with a tinned iron lid sloping down to a hole in the middle, so as to form a funnel through which the weevils can be dropped.

As the weevil, like many other kinds, seeks shelter by day, the stumps and other baits should be visited at different times, particularly at daybreak, to find out when the insects frequent them most; and the

stumps will probably last longer and keep fresher if protected from the sun with a light covering of leaves and fibre, which can be removed to get at the insects.

When no felling of palms is going on, other suitable baits are mangoes or other fruit crushed and allowed to ferment. It has been suggested (32) to cut wild palms in the neighbourhood in order to catch the beetles visiting the stumps. This is open to the objection that these palms must be carefully destroyed, or by becoming breeding places they will be more dangerous than if left standing.

Now the practice of attracting the weevils to fermenting mangoes cannot, however carelessly carried out, increase their numbers.

The search for weevils hiding in the crannies of the palms is more suitable for Indian plantations, where the trees are regularly examined to catch Rhinoceros beetles and the Palm Weevils are taken incidentally. It is simply a question of convenience and the amount of labour involved. Observations may be made to see if there is any hour when the weevils can best be taken on the trees. The females are the important sex, and any means of capture which only takes males will not limit the numbers of the next generation.

One advantage of the method of capture at baits is that it can be carried out by children and unskilled labourers.

Attraction by fires, into which the weevils plunge at night, has been tried in Asia, but the Palmetto Weevil, according to Summers, does not come to light.

5. *Encouragement of Insectivorous Animals.*

Till the habits of the weevils' natural enemies have been more studied, not much can be done in this way, and it is unlikely that there is at present any large destruction of insectivorous birds that requires checking.

Mr. Hunter in the Report (26) ascribed the immunity of his plantations to his keeping a herd of 190 pigs. The practice of letting swine forage is well known and employed in Continental forestry. They are greedy devourers of such large insects and grubs as they can find on the ground or by rooting.

Mr. Craig, another planter, states: "in a group four trees out of 25 " were not attacked, found that those four were infested with black " ants. Has tried to transplant ants, but failed; says the ants feed on " the eggs of the beetles.

" Did not understand the various stages of insect life; did not know " female ants; accidentally smoked some ants out of a tree five years " old; the next year it was attacked by beetles and died" (26).

The following notes on ants may therefore prove useful:—A colony of ants consists not only of males and females, but of neuter or worker ants. The latter are the forms commonly seen ascending trees, and gathering sticks, grain, insects, &c. Their size is small; and, after the large head, the segments of the thorax are very narrow, and together with the first one or two abdominal segments, resemble a chain of four or five beads joining the head and hind body, which are of nearly equal size; wings are absent. The neuters, of which there are often two kinds, the large-headed "soldiers" and the small-headed workers, cannot reproduce, so that an attempt to colonise them alone must fail. The males and females are much bigger, with a well-developed oval thorax, and a large abdomen which forms the chief mass of the body. They only appear above ground at the "swarming" time and then have long wings. The males soon die, and the females, the larger of the sexes, drop to the

ground, lose or tear off their wings, and are placed in nests by the workers, who tend them and their eggs and young. They are no more seen above ground, but can be found by examining the contents of an ant-hill. In temperate countries, at least, they die at the approach of winter, after which the nest only contains workers, and the eggs and grubs of the various forms. Ants have been frequently colonised with success in order to utilise them against other insects. The nest and its contents should be placed in a barrel and transferred to some suitable spot. The disagreeable task can be made more easy by smearing the boots of the labourers, the shafts of the tools used, and the margin of the barrel with grease, oil, or fresh tar. Many tropical species of ants are most injurious, for example, the Parasol ants which cut off and carry away leaves of many trees; therefore due care must be taken to see that a suitable species is selected for colonisation experiments. In the absence of information as to the particular kind found to be of service, figures of the male and worker of the Parasol ants are given on Plate II. 4*a*, 4*b*, which show sufficiently the differences between these two forms common to other species.

6. *The Cure of Injured Trees.*

This, though little tried in Honduras, has met with a certain amount of success in India.

One method is to cut into the soft parts of the tree, and extract the grubs. This requires great skill, both in observing the early stages of the injury—for it is useless to try it on a tree whose leaf-spike is manifestly dying—and in the operation itself. It is preferable not to attempt to reach the grub, but to kill it by the injection into its burrow of carbolic acid, kerosene, or Paris green suspended in water, but there is a risk of injuring the tree in this way. All wounds should be properly dressed with tar.

Another plan is to apply remedies to the head of the tree, which presumably are carried down to holes made by the grubs at the base of the spike. It is questionable whether these applications are not more of a prevention than a remedy.

An Indian native method of destroying them "is to hang little bags of "salt over the affected parts of the tree. Water is then poured over "the salt, so that the brine soaks into the borings and drives out the "beetle. It is believed that the latter will never return to a tree where "it has been subjected to the above treatment" (35).

The above quotation from a recent report is intended to refer to the Palm-Weevil. It appears, however, to the writer that the plan is used for the Rhinoceros beetle.

Other applications said to have met with success in some persons' hands are slaked lime, kerosene and arsenic; the latter is perhaps the best, and should be used as Paris green or London purple, stirred up in water in the proportion of about 1 oz. of Paris green and 2 of flour made into a paste, to 10 or 12 gallons of water and sprayed into the head of the tree. If the plant shows signs of injury a weaker solution should be used. Lime deserves a further trial, and nitrate of soda might be used. None of the above methods should be tried on a large scale till they are proved to be harmless to the plant. Firing the head of the tree as recommended for "fever" has also proved a cure, but the palm is greatly weakened, and a further attack is thereby invited. Perhaps the method of pouring poison into the holes is the most promising; according to Mr. Seay it has already met with some success.

The treatment of "fever," or whatever the disease may be, has been already given in the report of Mr. Fawcett (32). For such purposes a solution of sulphate of copper is hardly safe, as it will concentrate by evaporation in the bases of the leaf-sheaths and probably prove injurious; this is true to some extent of any powerful chemicals experimented with, and observations on their effect should be carried out for a long time and not merely for a week or two after application. Sulphate of copper can be much more safely employed in the form of *bouillie bordelaise* made as follows:—

1 lb. copper sulphate (bluestone).
1 lb. freshly burned quicklime.
5 gals. water.

The bluestone should be of good quality, and should be dissolved in water; the lime is slacked and stirred into the solution, which is made up to the proper quantity with water. It should be used fresh, and must be kept stirred, as the copper hydrate formed soon settles. It can be applied with a syringe or spraying pump, and is not to be regarded as an insecticide.

The above list of remedies is intended to include all that have been tried and are likely to be of success under different conditions. The protection of the trees against egg-laying by not trimming them, and the capture of the weevils are, together with the *careful* destruction of killed trees, the most promising.

Concerted action has been generally recommended to planters in respect to the destruction of trees, and in order to secure this ordinances have been proposed but not passed into law, both in British Honduras and the Straits Settlements. The reasons for and against such ordinances are in large measure independent of the soundness of the economic principles on which they are based. It may be desirable to destroy all infested trees, and yet it may be impolitic to enforce the execution of this work by the compulsion of a penal enactment.

Whether the impulse towards efficient treatment of the evil afforded by the interests of the individual is fitly supplanted by the coercion of the State is a question in ethics beyond the scope of the present paper; but it may be asked whether the destruction of injured trees is not likely to be as actively carried out by the co-operation of planters, who are clearly made to understand that it is to their interest and profit to do so, as it will be if they act under the orders of inspectors on whose capacity, tact and vigilance the success of the whole work will depend. For unless the duty of inspection be satisfactorily performed, the destruction will probably be more perfunctory than if the planter is left to his own devices.

Previous attempts to enforce penal enactments of a similar character have sometimes caused undesirable friction, and have resulted in troublesome and costly litigation, and though it may be said that no question of compensation can arise, as the destruction of dying and worthless trees alone is contemplated, this argument assumes the infallibility of the inspectors. A circumstance that may be held to justify such an enactment, namely, the necessity for exercising adequate supervision over small ill-kept native holdings, the owners of which cannot be made to understand the advantage of adopting sound economic methods, is not of importance in British Honduras.

From an economic standpoint alone the proposal to enforce the destruction of infested palms is not entirely satisfactory; for its inevitable effect will be to concentrate attention on that plan of treatment to the neglect of others which, though not less important, are unprovided for in the ordinance. Though the practice is in itself right and proper,

it will probably not remove all liability to damage without the assistance of proper cultivation in order to prevent egg-laying, and of the systematic capture of the weevils, neither of which methods can be suitably enforced by penalties, though the latter might, if thought desirable, be assisted by the State. Nothing short of the annihilation of all palms in the districts where cocoa-nut growing is practised will annihilate the weevils without the assistance of other methods, and an ordinance which does not provide for the destruction of the cohoon palms is incomplete. These are cut down by planters, not necessarily interested in cocoa-nut growing, who cannot fitly be included in the clauses of an enactment passed in the interests of another class of the community. If it is necessary to ensure the destruction of felled cohoon palms some other means must be sought.

VIII.—Systematic Notes.

In order to complete this account of the Palm Weevil, it is desirable to give the zoological characters of that species, together with a list of references to other insects mentioned incidentally.

ORDER. COLEOPTERA.

FAMILY. LUCANIDÆ.

Passalus (Eriocnemis) tridens, *Perch.*

Wiedemann. Zool. Mag. II. p. 109.

Percheron. *Mon. des Passales*, p. 24, pl. 2, fig. 3.
Castelnau. *Hist. Nat.* II. p. 179.
See also (15, 16).

FAMILY. DYNASTIDÆ.

Oryctes rhinoceros, *Linn.*

Linnæus. *Syst. Nat.* I. 2, p. 544.
Burmeister. *Handb. der Entomologie*, V. p. 199.
Dohrn. *Stett. Ent. Zeit.* XLI. p. 297.
See also (21, 22, 23, 27, 29, 30).

For injury to cocoa-nut trees in Réunion by the larvæ of *Oryctes tarandus*, Ol., and *insularis*, Coq., see Coquerel, *Ann. Soc. Ent. Fr.* (4), tom. VI. p. 334.

Xylotrupes gideon, *Linn.*

Linnæus. *Syst. Nat.* I. 2, p. 541.
Burmeister. *Handb. der Entomologie*, V. p. 266.
(Larva), De Haan. *Mémoire sur les Métamorphoses des Coléopteres*, in *Nouv. Ann. d. Mus. d'hist. nat.* 1836. IV. p. 115.

Megasoma (Megalosoma) actæon, *Linn.*

Linnæus. *Syst. Nat.* I. 2, p. 541.
Burmeister. *Handb.* V. p. 274.
Lucas. *Ann. Soc. Ent. Fr.* (4), tom. x, Bull., p. xli.
See also (15).

MEGASOMA (MEGALOSOMA) ELEPHAS, *Fabr.*

Fabricius. *Syst. Ent.* I. p. 7.
Chevrolat. *Guér. Mag. Zool.* 1843, p. 31, pl. 109, 110.
Girard. *La Nature*, 1886 (1), pp. 55–58.
See also (31).

FAMILY. CALANDRIDÆ.

For the characters of this family of weevils, see—

Lacordaire. *Genera des Coléoptères*, VII. pp. 267–270.
Leconte. *The Rhynchophora of N. America*, pp. 328, 329.

The family is very distinct, and besides many forms of moderate or small size it comprises the largest species of weevils known. They are all inhabitants of tropical or warm temperate countries, and none are indigenous in Britain, though two, *Sitophilus granarius* and *oryzæ*, are often found in granaries, whither they have been imported in corn or rice. The beetles feed almost without exception in various portions of monocotyledonous plants, and, besides the two species mentioned above, others are known to attack sugar cane and maize (*Sphenophorus*), cycads (*Phacecorynus*), bananas (*Sphenophorus*), &c. A list of the food plants of North American species is given in *Insect Life*, I. pp. 198, 199, but the *Cossonidæ* are included in accordance with the views of Leconte.

RHYNCHOPHORUS.

Herbst. *Natursyst. Käf.* VI. 1795, p. 3.
= *Calandra* (pars), Fabricius. *Calendra* (pars), Clairville. *Cordyle* (pars), Thunberg. *Cordylia*, Kirby.
Rhynchophorus, Schönherr, *Gen. Curc.* III. 2, p. 816.
Lacordaire. *Gen. des Col.* VII. p. 275.
Chevrolat. *Ann. Soc. Ent. France* (6), tom. ii. p. 560 *et seq.*

The distinctive character of this genus, which separates it from the other large *Calandridæ*, is the absence of any outwardly projecting lobes on the mandibles, which are furnished with three teeth biting on each other. The snout is strong and curved, stouter in the male, prismatic or crested, and with a brush of hair above the apex. Antennæ inserted at base of rostrum, funiculus six-jointed with joints 5, 6 transverse, club transverse securiform with spongy apex. Thorax flattened, sub-ovate, narrowed at apex with a transverse groove on either side. Elytra striate, abruptly truncate at apex, not covering pygidium. Legs nearly equal in length in both sexes, tibiæ with aspine at apex, third tarsal joint alone cordate, pilose below. Prosternum with a grooved posterior process behind anterior coxæ. Body smoother with fine velvety pubescence.

From this genus Chevrolat (*loc. cit.*) has separated off certain species to form the genera, *Omotemnus*, *Dynamis*, and *Paratasis*. He has not re-characterised the genus *Rhynchophorus* as thus restricted, and has enumerated in it 17 species, of which six belong to the New World. Since his paper four more species have been added from Africa and the Malay region.

The species of *Rhynchophorus* are variable in size, and in some cases in colour. They are therefore difficult to characterise, unless examined in an extensive series, and much work remains to be done in the genus. All of which the habits are known feed upon palms.

R. PALMARUM, *Linn.*

The American Palm-weevil.

Curculio palmarum. Linnæus, *Mus. Lud. Ulr.*, p. 42. 1. Olivier Ent. V. 83, p. 77. 4. Pl. 2, fig. 16, a, b.

Rhynchophorus palmarum. Herbst, *Col.*, VI., p. 5. 1. Pl. 60, fig. I.

Schönherr. *Gen. Curc.*, IV, ii, p. 820.

Calandra palmarum, Fabricius. *Syst. El.*, II., p. 430, 3.

Guilding. *Trans. Soc. Arts*, XLVI, p. 144.

Other references are given by Schönherr (*loc. cit.*).

See also (1, 2, 3, 5, 6, 7, 9, 11, 15, 17, 19, 20, 26, 28, 31, 32).

Deep black, above dull with velvety pubescence; below, shining. Head finely punctured with interocular sulcus; eyes approximate. Thorax flattened, narrowed towards apex, base slightly produced posteriorly, bisinuate on either side, with fine raised margin; finely and diffusely punctured, more strongly at sides and apex, with traces of a median longitudinal elevation. Scutellum large, elongate, produced at apex. Elytra with shoulders prominent, slightly narrowed to near apex with side almost straight, thence more abruptly narrowed, posterior border slightly emarginate; each with six deep striæ and traces of three more at sides, sutural stria not prolonged to base, fourth stria joining posteriorly with fifth, sometimes with sixth and seventh, interstices somewhat convex with feeble diffuse punctuation. Pygidium triangular with central elevation strongly punctured at base and sides, more diffusely in middle, with lateral margin of fuscous setæ. Underside finely punctured, the punctures being close on mesothorax and anterior part of metasternum and metathoracic episterna. Legs stout, set below with fuscous hairs, short on femora, longer on tibiæ; the latter with a long recurved spine at apex; third tarsal joint cordate, with fulvous pubescence.

Thorax and elytra somewhat variable in width.

Male.—Rostrum stout, almost straight, slightly recurved at apex with close confluent punctuation and trace of central keel, apical half set on upper surface with close erect pubescence. Pygidium wider, with trace of apical emargination.

Female.—Rostrum slender, uniformly curved from posterior third to apex, basal punctures weaker and less confluent than in male; setæ on anterior femora very short. Pygidium narrowed and more pointed at apex.

Length, exclusive of rostrum, 14½–20 lines; length of rostrum 5–7 lines.

Habitat.—Central and South America, West Indian Islands.

The British Museum collection contains two *Rhynchophori*, one labelled "Java," the other "Dr. Pearson, Darjeeling," which are indistinguishable from this American species. It is not possible, however, to establish an Asiatic record on the authority of two specimens without more history.

The only description of the *larva* that has any claim to scientific accuracy is that of Guilding (3), and no later one has been published. It has been figured by Merian (1), Herbst (2), Guilding (3), Blanchard (7 and 17). Of these figures the best are those of Guilding and

Blanchard (7). The larva of the allied species *R. cruentatus*, Fabr. (= *Zimmermannii*, Fähr.) has been described and figured by Candèze (12); as well as by Summers (13), and Dr. Horn (18).

There is a rough figure of the larva of *R. ferrugineus*, published by Ridley (30).

Description of Larva.

Stout, fusiform, largest at third or fourth abdominal segment, and diminishing rapidly from sixth posteriorly; with slight ventral curve as far as sixth abdominal segment thence recurved to anal extremity. Head corneous, oval, mouth at lower part; face inclined obliquely forwards, sides uniformly rounded, vertex somewhat flatter; median sagittal (epicranial) suture distinct throughout, bordered behind by a raised margin on either side, thence continued forwards as a fine impressed line dividing at upper third of face to form the lateral branches of the Y suture, which branches (frontal sutures) run to the inferior lateral angles of the face; on either side of the median suture a longitudinal suture running back from upper third of each frontal suture to become lost on occiput, bearing a setigerous pore at its anterior extremity and another midway between frontal suture and neck.

Surface of head above frontal sutures divided by fine furrows into small hexagonal areas, their surface depressed and dull with a slightly raised shining border; five to six bristle pits along either frontal suture and at the side of the head.

Face transversely rugose, with four longitudinal impressions, of which the middle are the deepest, and several bristle pits, one at anterior end of sagittal suture.

An ocellus on either side as a pale spot behind lower extremity of frontal suture, which separates it from the antenna, a small tubercle imbedded on the outer face of an eminence over socket of mandible.

Clypeus transverse, narrowed towards apex, anterior margin feebly incurved, a deep bristle-pore within each superior angle.

Labrum with two deep longitudinal furrows, margin not tri-lobed, closely set with stout curved bristles.

Mandibles short, robust, external surface convex with three deep pits on face, and three prominent condyles at base, inner surface not dentate, apex produced inwards and slightly backwards.

Maxillæ formed each of a conical cardinal piece, excavate on outer margin to receive basilar piece, which is produced on inner side into a lobe set on its elongate anterior face with a row of short bristles, outside apex of lobe a short palpus of two joints, the basal one double as broad as the apical joint; mentum subquadrate, narrowed towards apex, anterior border with a deep V-shaped emargination, surface with two longitudinal impressions, carrying a tri-lobed palpiger, the outer lobes inflated and bearing a palpus similar to that on the maxilla, the inner lobe carrying a rounded ligula with two deep pores on its posterior face: anterior to and connected with labium a thick bi-lobed and densely pubescent lingua.

Head somewhat variable in colour; usually deep pitchy brown, lighter on occiput and along sutures, face very dark, clypeus paler, sometimes testaceous, labrum pitchy; trophi deep pitchy brown, except mentum, cardinal pieces, palpi and ligula which are more or less testaceous. Specimens from sugar-cane in Guiana have the vertex and occiput much paler, sometimes testaceous, with four darker vittæ, two on sides of head, two along sides of sagittal suture.

Body with intersegmental sulci deep on ventral surface, less marked on dorsum, where between them secondary folds extend to sides of body, together with less marked tertiary folds, so that the dorsal surface of most segments forms three transverse ridges ; upper and lateral surfaces with close longitudinal wrinkles, absent over a median impression along vertical surface in which a series of raised pads are marked off by short transverse furrows ; last five abdominal segments with a similar dorsal series.

Pro-thoracic segment divided on dorsum by a transverse fold, its anterior part wide, covered above and at sides by a corneous plate, posterior part forming a small lappet-like ridge and together with dorsum of second and third thoracic segments bearing a number of small irregular corneous patches ; sides of each thoracic segment above ventral impression divided by furrows into three or four well marked corneous tubercles.

Anal segment corneous, produced into a flattened plate set at its edge with four setigerous tubercles, between which the margin is crenate ; above, a deep triangular depression with corneous surface, margined by prominent raised lips, and occupying the dorsum of the pre-anal as well as the anal segment.

Stigmata nine pairs ; the first well-developed, at lower angles of prothoracic shield, the following seven pairs minute, with black margins hidden in inter-segmental folds at anterior part of first seven abdominal segments ; the posterior pair well developed, situated on inner surface of raised margins bounding the triangular depression on dorsum of eighth abdominal segment.

Skin with a yellow velvety pile, worn off on raised callosities of thoracic segments, set at intervals with conspicuous circular bristle pores, arranged in eight longitudinal double rows on sides and ventral surface, less regularly on dorsum, bristles when present small and inconspicuous. Legs absent.

Length, $2\frac{1}{2}$ to 3 inches ; diameter 10 lines.

As the larvæ examined have been preserved in spirit, and thereby discoloured, the colour of the body is not described ; it appears to be a brownish yellow and is so represented in Guilding's excellent picture. Candèze describes nine pairs of stigmata in the larva of *R. cruentatus*, of which the eight abdominal pairs are very minute, and situated at the anterior part of their respective segments, whereas Horn states on the authority of Leconte that in that species abdominal stigmata are completely absent, and that he himself could find no trace of them in a carefully prepared skin. As nine pairs are present in the larva of *R. palmarum*, Leconte and Horn's statement cannot be accepted in place of Candèze's without further examination of the larva of R. *cruentatus*. It is, however, probable that the latter has incorrectly given the position of the posterior pair of stigmata, and that they are placed in both species on the dorsum of the eighth abdominal segment. This displacement of the hind pair has not, to the writer's knowledge, been described in any other terrestrial coleopterous larva (except in *Calandra* (*Phacecorynus*) *Sömmeri*, Burm. (4), in which the anterior abdominal stigmata are not aborted), but it is common in aquatic species. Its importance is obvious in the case of a grub living like the larva of *Rhynchophorus*, in a wet slimy burrow, a circumstance that may account for the almost rudimentary condition of the lateral abdominal stigmata. The posterior spiracles are each connected with a single very large tracheal trunk which runs forward along the side to the head, becoming gradually smaller and being connected anteriorly with the prothoracic stigma. The specimens ex-

amined were too decomposed to allow of the connexion with the first seven abdominal stigmata being carefully examined, but the communicating tracheæ are certainly very small. The writer has found that the presence of the posterior stigmata did not escape Guilding's attention. The objects shown as spiracles in some pictures of this larvæ are bristle-pores. Legs are entirely absent, for the most ventral series of thoracic tubercles represents them only in position and is probably not homologous; legs appear in one of Blanchard's plates (17), but the originals are really bristles.

Description of Pupa.

The general features of this are to be seen in the drawing (Pl. I. 3a, 3b). Rostrum extending to the base of the second pair of legs, with two transverse tubercular elevations above base of antennæ, and two small tubercles below; posterior part of prothorax asperate at sides; posterior legs covered by elytra and wings, the former widely separated and ending in a blunt process, the latter almost meeting in the middle line.

Length, 18–20 lines.

The immature insect is brownish black with the following parts brown or testaceous; the apex of the rostrum, the head and antennæ; the anterior border, and some patches at the sides of the thorax; the apex, of the elytra, a band along their margins and two or three bands on disc; the apical half of the tibiæ and the tarsi.

The attacks of *R. palmarum* on sugar-cane have been described by Guilding (3), Schomburgk (11), and Miss Ormerod (19). According to Schomburgk they seldom attack full-grown canes, but only those newly stuck into the ground. Miss Ormerod received specimens from Guiana, and sent them to the British Museum; it was thought that they belonged to two species, neither of which was *R. palmarum*. The writer has examined an imago of that consignment, now in Museum No. II. at Kew, and can discover no difference between it and *R. palmarum*, and the larvæ from sugar-cane agree with those from palms, except in the colour of the head, a minor point.

R. FERRUGINEUS. *Fabr.*

The Asiatic Palm-Weevil; "red-beetle"; "Kandapanuwa."
Calandra ferruginea, Fabricius, *Syst. El.* II. p. 433. 16.
Calandra Schach, id, loc. cit. p. 433. 17.
Rhynchophorus ferrugineus Herbst. *Col.* vi. p. 8. 2. Pl. 60., f. 3.
" " Schönherr. *Gen. Curc.* IV. 2. 827.
" " Chevrolat. *Ann. Soc. Ent. Fr.* (6) tom ii, p. 561.

For other names under which varieties have been described, see Schönherr (*loc. cit.*), or the Catalogue of Gemminger and von Harold. See also (21, 22 23, 24, 27, 29, 30, 35).

R. CRUENTATUS. *Fabr.*

The Palmetto-weevil.
Calandra cruentata. Fabricius.
Rhynchophorus Zimmermannii. Fåhræus in *Schön. Gen. Curc.* VIII. 2. p. 219.
Rhynchophorus cruentatus. Horn, *P. Am. Phil. Soc.* XIII. p. 408 *et seq.*

See also (13, 18, 32).

FAMILY. SIPALIDAE.

RHINA BARBIROSTRIS. Fabr.

Curculio barbirostris.	Fabricius.	*Syst. Ent.* p. 135. 45.
Rhina barbirostris.	Latreille.	*Gen. Crust. et Ins.* II. p. 269. 1.
„ „	Schönherr.	*Gen. Curc.* IV. 2. p. 792.

ORDER. HEMIPTERA—HOMOPTERA.

FAMILY ALEURODIDÆ.

ALEURODES COCOIS. Curt.

J. Curtis (Ruricola). *Gard. Chron.*, 1846, p. 284.
Frauenfeld. Verh. zool. bot. Ges. in Wien. xvii. pp. 793, 801.
Signoret. Ann. Soc. Ent. Fr. (4) tom. viii. pp. 398, 399.
See also (11), pp. 649, 650.

Though the name of this insect has been often referred to in connexion with cocoa-nut diseases, no accurate observations have been made on it since the time of Curtis and Schomburgk. It is clear that it is not a true *Aleurodes*, and according to Signoret the description and figure of its larva given by Curtis suggest affinities with the Scale-insects.

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Note.—In this bibliography are included all important works which describe or figure the early stages of *Rhynchophori*, as well as those giving the details of their life-histories.

W. F. H. Blandford.

London, February 1893.

EXPLANATION OF PLATES.

PLATE I.

THE AMERICAN PALM WEEVIL, *Rhynchophorus palmarum*, Linn.

FIG. 1.—The Perfect Insect:

a. Upper side of male.
b. Under side of male.
c. Head of male.
d. Head of female.

FIG. 2.—The Larva:

a. Lateral view, * prothoracic stigma.
b. Ventral view.
c. Dorsal view of posterior extremity, * posterior abdominal stigma.
d. Anterior view of head, with part of vertex more highly magnified.
e. Inner face of right mandible.
f. Maxillae and labium.

FIG. 3.—The Pupa:

a. Dorsal surface.
b. Ventral surface.

FIG. 4.—The Cocoon.

PLATE II.

FIG. 1.—The Bearded Weevil, *Rhina barbirostris*, Linn.:

a. The male.
b. The female.

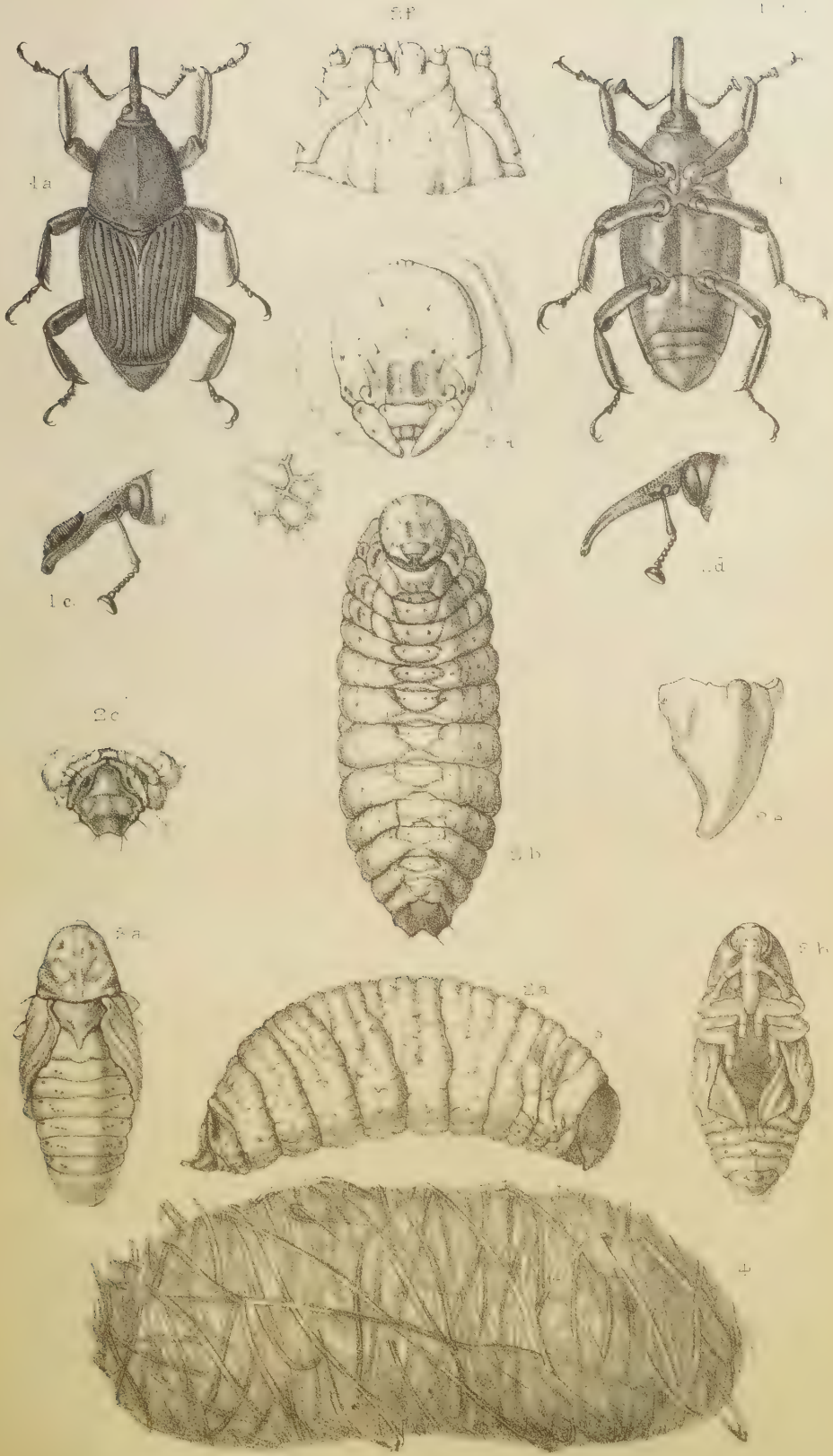
FIG. 2.—*Rhina nigra*, Drury (after Coquerel):

a. The larva.
b. The pupa.

FIG. 3.—The Elephant Beetle, *Megasoma elephas*, Fabr.

FIG. 4.—The Parasol Ant, *Oecodoma mexicana*, Smith (after Packard):

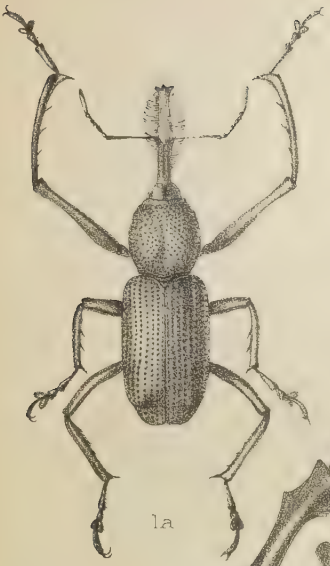
a. The female.
b. The soldier (worker-major).



R. Morgan del et lith.

West, Newman imp

Rhynchophorus palmarum, *Linn.*



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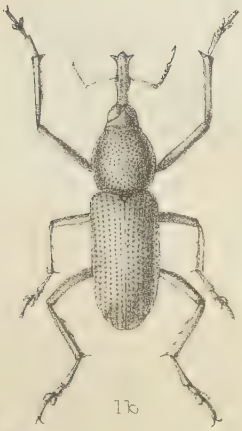

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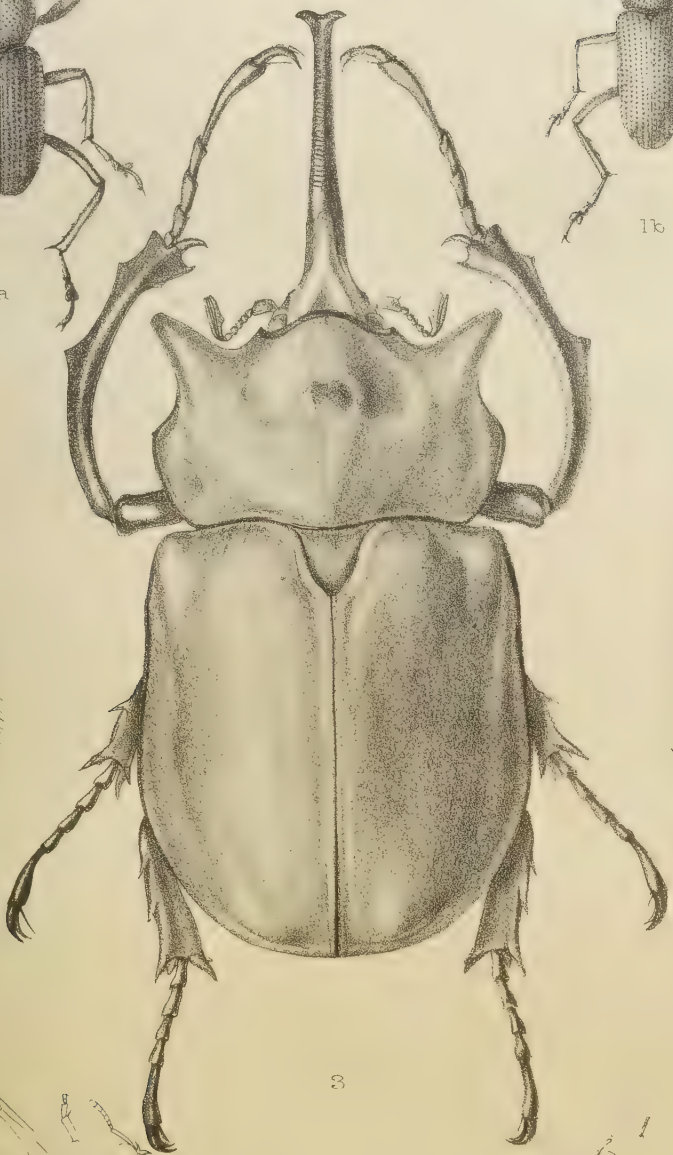

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West, Newman imp.

1. Rhina barbirostris, *Fabr.*
2. Rhina nigra, *Drury (after Coquerel.)*
3. Megasoma elephas, *Fabr.*
4. Œcodoma mexicana, *Smith (after Packard.)*

CCXCVI.—NEW ORCHIDS: DECADE 5.

41. **Physosiphon Lindleyi**, *Rolfe;* caulibus foliis brevioribus vel æqualibus, foliis anguste oblongis obtusis undulatis basi attenuatis, scapis foliis longioribus, bracteis spathaceis apice triangulis acutis, perianthii tubo triquetro oblongo lobis reflexis ligulato-oblongis apiculatis tubo æqualibus, petalis obovato-oblongis obtusis, labello trilobo lobis lateralibus erectis subcarnosis rotundatis lobo intermedio suborbiculari-oblongo margine recurvo, columna clavata, clinandrio late marginato.

Hab. Mexico, near Chiapas, *Linden*, n. 1234!

Caules 2 poll. longi v. ultra. *Folia* 2½–3½ poll. longa. *Scapi* 4 poll. longi. *Bracteæ* 2 lin. longæ. *Sepala* 7 lin. longa. *Petala* ½ lin. longa. *Labellum* ¾ lin. longum.

This is the largest-flowered *Physosiphon* known, the flowers measuring fully seven lines in length. A specimen, sent for determination by Mr. F. W. Moore, Glasnevin Botanic Garden, Dublin, in April 1892, without any note of its origin, proves identical with a dried one collected by M. J. Linden, as long ago as 1840, near Chiapas, Mexico. This specimen is wrongly labelled by Lindley, "*Physosiphon carinatum*," a species described by him in 1838 ("Bot. Reg.," xxiv., Misc., p. 72), from a specimen collected by Schiede, near Sosocola, Mexico. Lindley also states that it had been obtained in a live state from Mexico, by Mr. G. Barker, of Birmingham. This statement cannot be confirmed, as the specimen is not preserved in the author's Herbarium. Schiede's specimen is very imperfect, having lost all its flowers, though there are four loose ones in a capsule attached to the sheet. One only has the lip denticulate at the apex, as in Lindley's description and drawing, the others evidently belong to another species, but none of them agree with the one now described. If the flower just mentioned really belongs to Schiede's specimen, *P. carinatum* has flowers scarcely half as large as those of the present species. The lobes of the sepals of *P. Lindleyi* are deep orange-red or brick-red in colour, the tube and the rest of the flower light green. It may be placed next to *P. Loddigesii*, Lindl. Good specimens of *P. carinatum*, Lindl., and *P. emarginatum*, Lindl., would be welcome, as both are very imperfectly known.

42. **Bulbophyllum racemosum**, *Rolfe;* pseudobulbis suborbicularibus compressis monophyllis nitidis, foliis lineari-oblongis subobtusis coriaceis, scapo suberecto laxifloro, bracteis ovato-oblongis apiculatis cucullatis, pedicellis elongatis, sepalo postico elliptico-oblongo obtuso, lateralibus falcato-oblongis subobtusis, petalis ovato-oblongis obtusis, labello recurvo oblongo subobtuso carnoso lævi, columna brevissima alis minutis subulatis falcatis.

Hab. Borneo.

Pseudobulbi 1 poll. longi. *Folia* 4½ poll. longa, 1 poll. lata. *Scapus* 6 poll. longus. *Bracteæ* 3–4 poll. longæ. *Pedicelli* 1–1¼ poll. longi. *Sepalum posticum* 7 lin. longum, 4 lin. latum; *lateralia* 8 lin. longa, 3 lin. lata. *Petala* 4 lin. longa, 2 lin. lata. *Labellum* 2 lin. longum.

This distinct *Bulbophyllum* is nearly allied to *B. anceps*, Rolfe, in "Lindenia," viii., p. 33, t. 351, which is also a native of Borneo. In general habit the two resemble each other, quite as much as they differ from most other known species of the genus, but the present species has much larger flowers than *B. anceps*. They are honey-coloured, the dorsal sepal and the petals spotted with maroon, and the lateral sepals

minutely spotted on the upper half, and striped on the lower one with the same colour. The lip is purple, covered with numerous black dots, paler near the tip. The face of the column, also its foot, is spotted with purple on a pale ground. It flowered in the collection of Sir Trevor Lawrence, Bart., of Burford, Dorking, last August, when it was sent to Kew for determination.

43. **Cirrhopetalum brienianum**, *Rolfe;* pseudobulbis ovoideis monophyllis, foliis elliptico-oblongis obtusis coriaceis, scapo suberecto elongato gracili, floribus umbellatis, bracteis subulato-lanceolatis acutis, sepalo postico elliptico-oblongo concavo setifero ciliato, lateralibus connatis elongato-linearibus, petalis suborbicularibus ciliatis, labello recurvo oblongo-lanceolato subobtuso, columna brevissima dentibus minutis.

Hab. Borneo.

Pseudobulbi ½ poll. longi. *Folia* 2¼ poll. longa, ¾ poll. lata. *Scapus* 9 poll. altus. *Bracteæ* 1½–2 lin. longæ. *Sepalum posticum* 2½ lin. longum; *lateralia* 10–11 lin. longa. *Petala* ¾ lin. longa. *Labellum* 1½ lin. longum.

This species was introduced from Borneo by Messrs. Linden, of L'Horticulture Internationale, Brussels, with whom it flowered in March 1891, when it was sent to Kew for determination. A plant from the same source flowered with Mr. James O'Brien, of Harrow-on-the-Hill, in the following October. It belongs to the group having the dorsal sepal and petals ciliate or appendaged, and is allied to *C. makoyanum*, Rchb. f., in "Gard. Chron.," 1879, i., p. 234, next which it may be placed. The lateral sepals are light straw-colour, except a small portion near the base, which, as well as the greater part of the dorsal sepal, petals and lip, is very dark dull maroon.

44. **Cœlogyne borneensis**, *Rolfe;* pseudobulbis aggregatis basi ovoideis apice attenuatis gracilibus diphyllis, foliis obovatis apiculatis subsessilibus trinerviis, scapis erectis, racemis flexuosis multifloris, floribus heterochronicis, bracteis oblongo-lanceolatis subobtusis convolutis imbricatis deciduis, pedicellis gracilibus, sepalis oblongo-lanceolatis acutis concavis, petalis linearibus acutis, labello late elliptico trilobo lobis lateralibus rotundatis obtusis intermedio ovato subobtuso undulato, disco bicarinato, columna arcuata basi gracili apice late alata.

Hab. Borneo.

Racemi 5 poll. longi. *Bracteæ* 1 poll. longæ. *Pedicelli* 7 lin. longi. *Sepala* 7 lin. longa, 2 lin. lata. *Petala* 7 lin. longa, ⅓ lin. lata. *Labellum* 6 lin. longum, 4 lin. latum. *Columna* 5 lin. longa.

This species belongs to Lindley's small section *Flexuosæ*, and may be placed next to the Javan *C. longifolia*, Lindl., which has longer and narrower leaves, and the pseudobulb without a slender attenuated neck. It is a native of Borneo, whence it was introduced by Messrs. Linden, of L'Horticulture Internationale, Brussels, in whose collection it flowered last August. The flowers are whitish or light buff (this point remains doubtful owing to the flowers being somewhat withered), with red-brown reticulations on the side lobes of the lip, and some markings of similar colour on the front lobe. The pseudobulbs and leaves are described from a reduced sketch sent by Messrs. Linden.

45. **Epidendrum laucheanum**, *Rolfe;* caule elongato folioso, foliis lineari-lanceolatis attenuatis acutis, pedunculo terminali elongato compresso arcuato v. apice pendulo multifloro, bracteis lineari-lanceolatis acuminatis, sepalis elliptico-oblongis subacutis v. apiculatis, petalis

angustis oblanceolato-linearibus acutis, labello columnæ adnato cordato obtuso integro subconduplicato apice recurvo, columna clavata.

Hab. New Granada, at Popayan.

Caules circa 8 poll. longi. *Folia* $2\frac{1}{2}$–$6\frac{1}{2}$ poll. longa, 3–5 lin. lata. *Pedunculi* $\frac{3}{4}$–1 ped. longi. *Racemi* 3–8 poll. longi. *Bracteæ* 1–$1\frac{1}{2}$ lin. longæ. *Pedicelli* 2 lin. longi. *Sepala* 3–4 lin. longa, $1\frac{1}{4}$–$1\frac{1}{2}$ lin. lata. *Petala* 2–$2\frac{1}{2}$ lin. longa, $\frac{1}{3}$ lin. lata. *Labellum* $2\frac{1}{2}$–3 lin. longum, 2–$2\frac{1}{2}$ lin. latum. *Columna* 1 lin. longa.

A very distinct *Epidendrum* of the section *Spathium*, allied to *E. grandiflorum*, Lindl., but has leaves and flowers not half the size of that species, and the latter far more numerous and produced on a long flattened peduncle. The sepals and petals, as well as the peduncles and rachis, are of a light ochreous brown, or sometimes dull purple-brown, and the lip light glaucous green. It was introduced from Popayan by Messrs. F. Sander & Co., of St. Albans, with whom it flowered in November 1889. It was also received from Mr. F. W. Moore, Glasnevin Botanic Garden, Dublin, in September 1892.

46. **Epidendrum tricolor**, *Rolfe :* caule erecto subcompresso folioso, foliis lineari-oblongis subobtusis, racemis pendulis multifloris, floribus subsecundis, bracteis lanceolatis acutis, sepalis oblongo-lanceolatis acuminatis, petalis filiformibus, labello adnato trilobo lobis lateralibus parvis erectis late rotundatis intermedio elliptico acuto, disco tricarinato, columna clavata.

Hab. Venezuela.

Caulis 5 poll. longus v. ultra. *Folia* 3–4 poll. longa, 6 lin. lata. *Racemi* 4–5 poll. longi. *Bracteæ* $\frac{1}{2}$ lin. longæ. *Pedicelli* $2\frac{1}{2}$ lin. longi. *Sepala* 3–4 lin. longa. *Petala* 3 lin. longa. *Labellum* $2\frac{1}{2}$ lin. longum. *Columna* $1\frac{1}{2}$ lin. longa.

A graceful little species, imported from Venezuela (together with *Cattleya Mossiæ*, Hook.) by Messrs. Hugh Low & Co., of Clapton, with whom it flowered last November. It is closely allied to *E. purum*, Lindl., but is readily distinguished, among other characters, by its orange-coloured lip. The sepals and thread-like petals are light yellow, and the column green. The flowers are small and numerous, and smell remarkably like cucumber.

47. **Stanhopea Lowii**, *Rolfe ;* pseudobulbis ovoideis, racemis pendulis bifloris, sepalo postico oblongo subobtuso concavo, lateralibus ovatis subobtusis, petalis elliptico-oblongis subacutis, labello valde carnoso, hypochilio subgloboso ore obcordato-orbiculari lævi prope apicem utrinque obtuse dentato mesochilio crasso integro truncato apice utrinque carinato-alato epichilio triangulo subobtuso convexo, columna arcuata supra medium late alata apice ovato-triangula subobtusa.

Hab. New Granada.

Pseudobulbi $2\frac{1}{4}$ poll. longi. *Sepalum posticum* $2\frac{3}{4}$ poll. longum, $1\frac{1}{4}$ poll. latum; *lateralia* $2\frac{1}{2}$ poll. longa, $1\frac{3}{4}$ poll. lata. *Petala* $2\frac{1}{8}$ poll. longa, $1\frac{1}{8}$ poll. lata. *Labellum* 2 poll. longum; hypochilium 1 poll. longum; mesochilium $\frac{1}{2}$ poll. longum; epichilium 5 lin. longum, basi 4 lin. latum. *Columna* $2\frac{1}{2}$ poll. longa.

This handsome *Stanhopea* is allied to *S. eburnea*, Lindl., and *S. reichenbachiana*, Roezl., differing from the former in its globose hypochil and differently-coloured flowers, and from the latter (known only from description) in having the mesochil solid, not deeply channelled, as Reichenbach twice distinctly states in his description. The character is an essential one in the genus, otherwise the distinctness of

the present one might be doubted. *S. Lowii* was introduced from New Granada by Messrs. Hugh Low & Co., of Clapton, and flowered in their collection last December. The sepals and petals are of a creamy buff shade, the latter with numerous minute brown spots on the disc. The lip is ivory-white, the upper half of the hypochil with bands of dull maroon, formed of numerous suffused spots with some scattered dots between them. The column is pale green, with ivory-white wings. The flowers exhale a powerful, almost Narcissus-like fragrance.

48. **Aërides platychilum**, *Rolfe;* foliis lineari-oblongis obtusis, scapis descendentibus arcuatis multifloris, bracteis latissime triangulo-ovatis subobtusis, sepalo postico elliptico-oblongo obtuso, lateralibus majoribus triangulo-ovatis obtusis ad pedem columnæ adnatis, petalis elliptico-oblongis obtusis, labello plano trilobo lobis lateralibus oblongis obtusis intermedio latissime ovato-oblongo apice breviter bilobo, disci nervis paullo incrassatis, calcare valide reflexo conico obtuso, columna brevi.

Hab. Not recorded.

Folia 6 poll. longa, 1¼ poll. lata. *Scapi* 5 poll. longi. *Bracteæ* 1 lin. longæ. *Pedicelli* 1 poll. longi. *Sepalum posticum* 4–5 lin. longum, 2½ lin. latum; *lateralia* 5 lin. longa, basi 4½ lin. lata. *Petala* 4–5 lin. longa, 2½ lin. lata. *Labellum* 9 lin. longum, 8 lin. latum; *calcar* 3 lin. longum.

This distinct and pretty *Aërides* flowered with Mr. F. W. Moore, Glasnevin Botanic Garden, Dublin, in April 1892, when it was sent to Kew for determination. Nothing is known of its native country. It is allied to *A. houlletianum*, Rchb. f., having similar colours and a very sharply reflexed spur, but the lip is flat, not plicate, and the side lobes are free for less than half their length, not divided nearly to the base and spreading. The sepals and petals are light buff, with a faint purple stain near the tips. The lip is flat or slightly convex, pale yellowish white, the side lobes transversely barred with light purple, the front one with the middle and apex bright purple, and a few similar spots on the sides. The spur is buff-pink. It is an interesting addition to the genus.

49. **Saccolabium mooreanum**, *Rolfe;* foliis lineari-oblongis apice brevissime bilobis, scapis descendentibus, racemis densifloris brevibus, floribus parvis, bracteis lineari-lanceolatis acuminatis, sepalis conniventibus elliptico-oblongis obtusis concavis, petalis conniventibus late ellipticis obtusis, labello carnoso trilobo lobis lateralibus semiorbicularibus erectis intermedio triangulo-ovato obtuso concavo, calcare clavato elongato, columna brevi fronte in appendicem decurvum bicuspidatum producta.

Hab. New Guinea.

Folia 4–6 poll. longa, 1½ poll. lata. *Scapi* 5–8 poll. longi. *Racemi* 1–2 poll. longi. *Bracteæ* 1–2 lin. longæ. *Pedicelli* 2–3 lin. longi. *Sepala* et *petala* 2 lin. longa. *Labelli limbus* 1¼–1½ lin. longus; *calcar* 2–3 lin. longum.

A small-flowered *Saccolabium*, introduced from New Guinea (together with *Dendrobium Phalænopsis*) by Messrs. F Sander & Co., of St. Albans, and now represented in several collections. It flowered with Mr. F. W. Moore, Glasnevin Botanic Garden, Dublin, in October last, then with Sir Trevor Lawrence, Bart., of Burford, Dorking, in November, and shortly afterwards with C. J. Lucas, Esq., Warnham Court, Horsham, from all of whom specimens were received for determination. It is allied to *S. Mimus*, Rchb. f., and two or three other Polynesian species, which have a peculiar decurved appendage in front of the column, looking down, as it were, into the spur, as in the genus

Uncifera. The flowers of *S. mooreanum* are densely arranged in a short cylindrical raceme, light rose-colour, each of the segments tipped with green, and the side lobes of the lip and the column white.

50. **Angræcum bistortum.** *Rolfe*; caule scandente radicante, foliis distichis sessilibus lineari-oblongis breviter et inæqualiter bilobis lobis rotundatis, racemis foliis brevioribus paucifloris, bracteis tubuloso-vaginatis apice obliquis subobtusis, floribus secundis, sepalis reflexis ovato-lanceolatis apice subattenuatis subacutis lateralibus subobliquis, petalis paullo angustioribus, labello ovato-lanceolato subacuto, calcare elongato bistorto apice bractea tubulosa includente, columna brevissima, pollinarii glandula lanceolato-lineari pollinis ovoideis stipitibus geminis.

Hab. W. Trop. Africa, Lagos, *Moloney!*

Folia 3–5 poll. longa, ¾–1¼ poll. lata. *Racemi* 2¼ poll. longi. *Bracteæ* 2 lin. longæ. *Pedicelli* 4 lin. longi. *Sepala* et *petala* 4 lin. longa. *Labelli calcar* 9–10 lin. longum.

This species is allied to *Angræcum arcuatum*, Lindl., and *A. chailluanum*, Hook. f., but has considerably smaller flowers, with the additional peculiarity that the spur is curved into a loop, and its tip remains tightly clasped by the sheathing bract; in which respect it appears to differ from every other species in the group. This character, which seems quite constant, gives the spur the appearance of a looper caterpillar. It evidently arises from the unequal growth of the pedicel and spur. When the flowers are quite young these two organs are equal in length, and the tip of the spur is enrolled by the sheathing bract. Then the spur elongates rapidly, but failing to free itself forms a double bend, in allusion to which the name is given. It was collected in the interior of the colony of Lagos, West Africa, by His Excellency Sir Alfred Moloney, K.C.M.G., and was brought to Kew by Mr. J. McNair, late Curator of the Lagos Botanical Station. It flowered at Kew in January 1892.

CCXCVII.—MISCELLANEOUS NOTES.

Mr. Daniel Dewar, Foreman of the Herbaceous Department in the Royal Gardens, has been appointed Curator of the Botanic Garden at Glasgow.

Mr. Walter Irving, a member of the gardening staff of the Royal Gardens, has been appointed Foreman (on probation) of the Herbaceous Department in succession to Mr. Dewar.

Mr. Robert L. Harrow, a Sub-foreman in the Royal Gardens, has been appointed a Foreman at the Royal Botanic Garden at Edinburgh.

Mr. Gustav Hermann Krumbiegel, a Sub-foreman in the Royal Gardens, has been appointed Superintendent of the State Gardens under the Government of His Highness the Maharaja Gaekwar of Beroda, in the Bombay Presidency.

Mr. Frederick Enos Willey, in the employ of the Royal Gardens, has been appointed Acting Curator of the Botanical Station at Aburi, under the Government of the Gold Coast, during the absence on leave of Mr. W. Crowther.

Melhania erythroxylon, Ait.—This is the redwood of St. Helena, an endemic tree 20 feet high, bearing large tubular flowers, white when first expanding, changing in a day or two to pink, and finally to red. It is now almost extinct in the island. In 1883 Mr. Morris, the Assistant Director of Kew, when on a visit to St. Helena brought home seeds of this plant, which were widely distributed. Plants were successfully grown at Jamaica and put out at the Hill Garden attached to the Government Cinchona Plantations. It is doubtful, however, whether any of them have since survived, as the tree is, evidently, difficult to grow under cultivation to a mature state. One of the last of the plants raised from the same seed at Kew was killed during the winter of 1891. It would be interesting to learn whether the tree has been successfully grown elsewhere outside St. Helena. In order to make further trial of it application for a good supply of seed was made a short time ago to Mr. W. Grey Wilson, C.M.G., Governor of St. Helena. This was obligingly sent in November last, and a portion was at once distributed to the following botanical gardens, viz.:—Berlin, Edinburgh, Glasnevin, Paris, Antigua (Leeward Islands), Hakgala (Ceylon), Jamaica, Natal, Port Elizabeth, Sydney, Trinidad, and to T. Hanbury, Esq., at Mentone. The seeds sown at Kew germinated in a few days, and there are now numerous healthy young plants.

Californian Plants.—Kew is indebted to Professor E. L. Greene, of the University of California, for a parcel of about 300 dried plants, from western North America, mostly from California, and largely consisting of types of novelties described by him from time to time. The specimens are excellent, and form a valuable addition to the Herbarium.

Garbelling of Spices.—Probably few persons of the present generation understand what was meant by "garbelling of spices." though the use of the term may still linger in the trade. The sense in which it is used in this connexion is to pick, cleanse, and sort into different qualities. In the gift of books to Kew from Mr. Thos. Hanbury, F.L.S., referred to in the last number of the *Bulletin*, p. 22, is a pamphlet of 87 pages entitled:

A profitable and necessarie Discourse for the meeting with the bad Garbelling of Spices, used in these daies. And against the Combination of the vvorkemen of that office contrarie vnto common good. Composed by diuers Grocers of London, wherein are handled such principall matters as followeth in the Table before the booke. Printed at London, by R. B. for Thomas Man dwelling in Pater noster Row at the signe of the Talbot.

There is no printed date on the title page, but 1592 has been added in manuscript. This is the date given in the British Museum catalogue, and it is also in a measure confirmed by the date 1590 at the foot of a form of "oath we mean to take," p. 61. Apart from the information it contains on the duties and emoluments of a garbeller, this little book is interesting as a record of the various kinds of spice offered for sale at the time. Some have quite fallen out of use, and others are now differently applied or differently spelled; thus, mases (mace), gallingall (*Cyperus longus?*), setwall (zedoary), Moreswax and Stavesacre (seeds of *Delphinium Staphisagria*). However, there was then no established orthography for many of the names, and some of them are very diversely spelled in different parts of this quaint book.

Visitors during the Year 1892. — In the *Kew Bulletin*, 1892, p. 51, a review was given of the number of visitors to the Royal Gardens during the last 50 years. It was shown that there had been a gradual increase of visitors from 9,174 in the year 1841 to 1,373,753 in 1891. The detailed numbers for last year (1892) are as follows :—

Month.	Numbers.	Month.	Numbers.
January - - -	21,583	Brought forward -	682,008
February - - -	20,757	July - - -	201,857
March - - -	44,945	August - - -	244,969
April - - -	179,745	September - -	128,964
May - - -	166,013	October - -	47,164
June - - -	248,965	November - -	30,367
		December - - -	18,828
Carried forward -	682,008	Total - -	1,354,157

The total number of visitors for 1892 was 1,354,157. The total for 1891 was 1,373,753. There was, therefore, a slight falling off last year. The total attendance on Sundays was 587,880; on week days 766,277. The greatest monthly attendance (June) was 248,965; the smallest monthly attendance (December) was 18,828. The greatest Sunday attendance (on July 31st) was 34,743; the smallest Sunday attendance (on January 17th) was 980. The greatest week day attendance (on June 6th, Whit Monday), was 82,571; the smallest week day attendance (October 28th) was 146.

Coffee Disease. — A disease of coffee first noticed in Mysore, Southern India, and known as "leaf rot" or "Koleroga," was described by Dr. M. C. Cooke, under the name of *Pellicularia Koleroga* (see *Kew Report*, 1876, p. 20). A separate report on the subject with coloured illustration was issued by the India Office [April 1876]. The fungus is external in its growth, and covers the leaves with a slimy gelatinous matter. The leaves afterwards turn black and rot at the tips or fall off. The same disease was found by Dr. Ernst on coffee in Venezuela, where it was known as "Candelillo." The identity of the fungus in both localities was fully accepted by the Rev. M. J. Berkeley and Dr. Cooke. The discovery of a parasitic fungus of a very specialised type in coffee plantations both in the Old and New World was regarded at the time as a somewhat remarkable circumstance. The inference

was that the disease had possibly been introduced into Mysore from South America. Of late years little has been heard of the disease in either hemispheres. It was at no period so virulent in its character as the well-known coffee-leaf disease of Ceylon (*Hemileia vastatrix*), and with ordinary care on the part of cultivation it was not anticipated it would become a formidable enemy to coffee cultivation. Interest in this disease has now been revived, as it has been found by Mr. T. D. A. Cockerell on coffee in Jamaica, where, however, it was suspected to have existed for some time. Reference is evidently made to it in the following words, which appeared in the *Kew Report*, 1876, p. 20 :—"A some- "what similar disease to the *Pellicularia*, but described in too vague a "manner to speak definitely upon, seems to have occurred in 1864 in "Jamaica, the leaves of the coffee plants being covered 'with a white "substance of a gelatinous nature.'" Further, in the *Kew Report*, 1877, p. 27, it is stated, after showing the identity of the "Koleroga" of Mysore with the "Candelillo of Venezuela, that "it is possible that the "disease which I mentioned last year as having occurred in Jamaica "may also be identical with the 'Candelillo.'" In forwarding a specimen to Kew Mr. Cockerell states that the diseased leaves were found on an estate in the neighbourhood of Mandeville. The disease was quite local in its character though abundant in one spot. As it is external in its habit it is needless to add that it may be easily treated in the early stages with powdered lime and sulphur. The fallen leaves should be carefully gathered and burnt at regular intervals. The latter treatment is probably the more convenient to the planter, and if carried out with care and regularity it might be sufficient to keep the disease from spreading to other plantations. The coffee industry in Jamaica is confined to two comparatively small areas, one in the parish of Manchester at an elevation of 1,500 ft. to 2,500 ft., and another in the Blue Mountains at elevations up to 6,000 ft. The best qualities of Jamaica coffee (for which the highest prices reach 135*s.* to 142*s.* per cwt.) are entirely produced in the Blue Mountains district. The occurrence of the present disease in Jamaica coffee suggests that careful steps should be taken to prevent it from spreading and that cultivators should be keenly alive to notice the existence of any disease on their coffee trees, in order that prompt and decisive action may be taken to prevent serious injury.

Grape Rust.—A specimen of grape rust on leaves of the common vine (*Vitis vinifera*) in Jamaica has just been forwarded to Kew by Mr. Theo. D. A. Cockerell, Curator of the Museum of the Institute of Jamaica. Mr. Cockerell describes the fungus in the following extract from *Notes from the Museum*, No. 28 :—"On Nov. 8th, I found a num- "ber of grape vines in the vicinity of Kingston severely attacked by a "parasitic fungus. This pest appears on the under-side of the leaves "and looks like an orange-yellow powder, irregularly scattered over the "surface. . . . Specimens of this fungus were sent to Mr. B. T. "Galloway, of the United States Department of Agriculture, who writes "that it is *Uredo Vialæ*, the only rust fungus known to attack the grape." *Uredo Vialæ*, Lagerheim was described from Jamaica specimens obtained at Rockfort (near Kingston) in 1890. The disease had, however, been noticed in Jamaica in 1879, and specimens of leaves were forwarded to Kew and submitted to the late Rev. M. J. Berkeley (*Report Jamaica Bot. Department*, 1880, p. 24). Mr. George Massee

has now identified the same fungus as *Uredo vitis*, Thüm., and he has furnished the following note giving the history of its occurrence :—

" *Uredo vitis*, Thümen, Die Pilze des Weinstockes, p. 182, tab. 5, fig. 10 (1878), was described from specimens parasitic on living leaves of *Vitis vinifera* from Aiken, S. Carolina, collected by H. W. Ravenel. Specimens of this fungus were sent to the Rev. M. J. Berkeley in 1879 from Jamaica by Mr. D. Morris, at that time Director of the Botanic Gardens in Jamaica. The fungus now sent by Mr. T. D. A. Cockerell to Kew from Jamaica, and determined by Mr. B. J. Galloway, of the United States Department of Agriculture, to be *Uredo Vialæ*, Lag., proves to be identical with *Uredo vitis*, Thüm., as proved by comparison with a portion of Thümen's type specimen, now in the Kew Herbarium. The type of Lagerheim's species, *Uredo Vialæ*, was collected near Kingston, Jamaica, and is undoubtedly synonymous with *U. vitis*, Thüm., the somewhat imperfect description of the latter having led to the founding of a second species. The aecidial form of the fungus is mixed with the uredo-form in Mr. Morris's specimens." A treatment for this disease in vines might be devised as already recommended in the case of the coffee disease. In the younger stages of the disease it would be found useful to dust the growing leaves, as well as the surface of the soil, at frequent intervals with sulphur, or a mixture of sulphur and lime. When the orange-yellow spores are already developed any remedial treatment then is practically useless. The leaves should, however, be carefully collected and burnt, in order to lessen the danger of the fungus spreading to other plants.

Tropical Agriculture. — An introductory Text Book of Tropical Agriculture has been published by Messrs. Macmillan & Co. from the pen of Dr. H. A. Alford Nicholls, M.D., F.L.S., of Dominica. It is a crown octavo volume of 312 pages, the published price being 6*s.* per copy. This is practically the English edition of a work that obtained the premium of 100*l.* offered by the Government of Jamaica. It was first of all published at the Government Printing Office at Jamaica, and adopted as a text book for the use of the colleges and higher schools in that Colony. It has since been adopted by the Government of other colonies, and it is evident, as stated by the author, " that it has supplied a distinct want." The first part deals with the elementary principles of tropical agriculture connected with a consideration of soils, plant life, climate, manures, rotation of crops, drainage, irrigation, tillage operations, pruning, budding, and grafting. In the second part the application of these principles to the various cultivations undertaken in tropical countries is considered, and useful hints given respecting coffee, cocoa, tea, sugar-cane, fruits, spices, drugs, and food plants. This part appears to be a " record of experience that has been " gained by study, observation, and experimental cultivations " undertaken in many cases by the author himself. The information presented is thoroughly sound and suited to the requirements of " peasant pro- " prietors, the owners of small estates, and to intending settlers in foreign " countries."

Ferns of South Africa.—Mr. T. R. Sim, Curator of the Botanic Garden of King William's Town, has just published a handbook of the Ferns and Fern Allies of South Africa. It contains descriptions of all the species, 179 in number, which are known to occur south of the tropic of

Capricorn, and plates of nearly all of them. Of these 179 species, only 42 are peculiar to the Cape, 75 of the 157 true ferns being found in the south-west district, 78 in the south-east, 89 in Kaffraria, 61 in the Transvaal, and 130 in Natal. The synonymy of the species is carefully worked out, and their distribution traced through the seven geographical districts established by Mr. Bolus. The fern-flora of South Africa does not show the same richness and remarkable individuality which characterises the Phanerogamic botany of the Colony, and continental Africa as a whole is much poorer in ferns and in endemic species than Asia and America. Madagascar, Mauritius, and Bourbon have a very rich fern-flora. Mr. Sim is far behind the time in stating the number of ferns known in Madagascar at 144. The number of species at present known is 366. The per-centage he states for the number of ferns peculiar to Africa (67 per cent.) is far too high. The proper number for the Seychelles is 80, not 30. The book, with its plates, makes all about the Cape ferns so clear, that no doubt it will give a great impulse to the collecting and study of ferns by the inhabitants of the colony.